551.573
1 58
W4 WR

W. B. No. 610

MAY 7 1917
UNIV. OF MICH.

U. S. DEPARTMENT OF AGRICULTURE
WEATHER BUREAU
CHARLES F. MARVIN, Chief

MONTHLY WEATHER REVIEW

VOLUME 45, No. 2

FEBRUARY, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

FEBRUARY, 1917.

CONTENTS.

	Page.
INTRODUCTION	47
SECTION I.—AEROLOGY:	
Solar and sky radiation measurements during February, 1917. H. H. Kimball	48
The smoke cloud and the high haze of 1916. H. H. Kimball.	49
Free-air data in the Hawaiian Islands, July, 1915. Col. W. E. Ellis	52
Weather Bureau exhibit at the First Pan-American Aeronautic Exposition. W. R. Gregg. (6 figs.)	55
Sound areas of the explosion at East London, January 19, 1917. Charles Davison	55
Parhelic circle with two pairs of parhelia at Fargo, N. Dak. C. L. Meller	56
SECTION II.—GENERAL METEOROLOGY:	
Competency of wind in land depletion. C. R. Keyes	57
Reduction of air temperatures at Swedish stations, to a true mean. Nils Ekholm. (Abstract)	58
Formation of winter stratus; Depth of northeast wind. Douglas Manning	60
Atmospheric circulation and the weather in Argentina. H. H. Clayton. (Abstract)	60
Argentine Meteorological Service. W. G. Davis. (Abstract)	60
Report of the meteorological station at Berkeley, Cal., for the year ending June 30, 1915. W. G. Reed. (Abstract.) (3 figs.)	61
SECTION III.—FORECASTS:	
Forecasts and warnings for February, 1917. E. H. Bowie	68
SECTION IV.—RIVERS AND FLOODS:	
Rivers and floods, February, 1917. A. J. Henry. (Chart I).	
Great Lakes levels during February, 1917	72
SECTION V.—SEISMOLOGY:	Page.
Seismological reports, February, 1917. W. J. Humphreys	
Seismological dispatches	73
SECTION VI.—BIBLIOGRAPHY:	
Recent additions to the Weather Bureau library. C. F. Talman	78
Recent papers bearing on meteorology and seismology. C. F. Talman	78
SECTION VII.—WEATHER AND DATA FOR THE MONTH:	
Weather of the month. P. C. Day	80
Weather conditions over the North Atlantic during February, 1916 (with Chart IX)	81
Condensed climatological summary	84
Tables—	
Description	84
I. Climatological data for United States Weather Bureau stations	85
II. Accumulated amounts of precipitation	88
III. Data furnished by the Canadian Meteorological Service	90
Charts—	Charts.
I. Hydrographs, February, 1917	10
II. Tracks of centers of HIGHS	11
III. Tracks of centers of LOWS	12
IV. Departures of mean temperatures	13
V. Total precipitation for the month	14
VI. Percentage of clear sky	15
VII. Sealevel isobars and isotherms, and prevailing winds	16
VIII. Total snowfall for the month	17
IX. Marine meteorological data for February, 1916	18

NOTICE TO CONTRIBUTORS.

Contributions intended for publication in any given issue of the MONTHLY WEATHER REVIEW (e. g., January) should be in the hands of the Editor before the end of the next following month (e. g., February), if no illustrations are required. When the paper is illustrated, the manuscript and the copy for the illustrations must be submitted much earlier, in order to permit copy being prepared for the engraver by the end of the month.

REPRINTS are made up without covers in the original size and pagination of the REVIEW. They will not be furnished unless specifically REQUESTED WHEN THE MANUSCRIPT IS SUBMITTED.

MONTHLY WEATHER REVIEW

CLEVELAND ABBE, jr., Editor.

VOL. 45, No. 2.
W. B. No. 610.

FEBRUARY, 1917.

CLOSED APR. 3, 1917
ISSUED APR. 30, 1917

INTRODUCTION.

As explained in this introduction during 1914, the MONTHLY WEATHER REVIEW now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

SUPPLEMENTS TO THE MONTHLY WEATHER REVIEW are published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies.

Beginning August, 1915, the material for the MONTHLY WEATHER REVIEW has been prepared and classified in accordance with the following sections:

SECTION 1.—*Aerology.*—Data and discussions relative to the free atmosphere.

SECTION 2.—*General meteorology.*—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

SECTION 3.—*Forecasts and general conditions of the atmosphere.*

SECTION 4.—*Rivers and floods.*

SECTION 5.—*Seismology.*—Results of observations by Weather Bureau observers and others as reported to the Washington office. Occasional original papers by prominent students of seismological phenomena.

SECTION 6.—*Bibliography.*—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

SECTION 7.—*Weather of the month.*—Summary of local weather conditions; climatological data from regular Weather Bureau stations; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto; Meteorological Summary and chart No. 9 of the North Atlantic Ocean for this month in 1915. Owing to the fact that ocean meteorological data are frequently not available for a considerable time after the close of the month to which they relate, the chart and text matter in connection therewith appear one year late.

In general, appropriate officials prepare the seven sections above enumerated; but *all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.*

The voluminous tables of data and text relative to local climatological conditions, that during recent years were prepared by the 12 respective "district editors," are omitted from the MONTHLY WEATHER REVIEW, but collected and published by States at selected section centers.

The data needed in Section 7 can only be collected and prepared several weeks after the close of the month designated on the title-page; hence the REVIEW as a whole can only issue from the press within about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belén College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

The Weather Bureau desires that the MONTHLY WEATHER REVIEW shall be a medium of publication for contributions within its field, but such publication is not to be construed as official approval of the views expressed.

CORRIGENDA.

REVIEW, *January, 1917:*
Page 15, column 2, next to last line in footnote 42. *For* "prestened" *read* "presented."

89756—17——1

SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING FEBRUARY, 1917.

By HERBERT H. KIMBALL, Professor of Meteorolgy.

[Dated: Washington, D. C., March 31, 1917.]

For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1917, **45**:2.

The monthly means and departures from normal values in Table 1 show that direct solar radiation averaged slightly below its normal intensity at Washington, D. C., and above its normal intensity at the other three stations.

At noon of February 1 an intensity of 1.66 calories per square centimeter of normal surface was measured at Lincoln, Nebr., and at noon of the same day an intensity of 1.65 calories was measured at Santa Fe, N. Mex. The measurement at Lincoln is the highest ever obtained at that station, and that at Santa Fe is the highest ever obtained there in February. At noon of the 9th a measurement of 1.55 calories was obtained at Madison, which is only about 1 per cent less than the highest February reading for that station.

TABLE 1.—*Solar radiation intensities during February, 1917.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Feb. 2			1.16			0.82		0.67	0.61	
3			1.26	1.11	1.01	0.89	0.78			
5			1.03	0.89	0.77	0.67	0.58			
6		1.48	1.36	1.26	1.16	1.06	0.98	0.91		
10		1.42	1.24	1.16	1.06	0.98	0.91	0.84	0.77	0.72
13		1.37	1.28	1.22	1.20	1.15	1.10	1.07		
17		1.29	1.20							
Monthly means		**1.39**	**1.22**	**1.13**	**1.04**	**0.93**	**0.87**	**0.87**	**(0.69)**	**(0.72)**
Departure from 9-year normal		**−0.02**	**−0.03**	**−0.02**	**−0.03**	**−0.05**	**−0.03**	**+0.01**	**−0.10**	**−0.08**
P. M.										
Feb. 1			1.09							
3			1.38	1.27	1.18	1.11	1.07	1.02	0.92	0.86
5			0.99	0.76	0.65	0.55	0.48	0.42	0.37	0.33
6			1.36	1.25	1.17	1.11	1.05	0.99	0.95	0.90
10			1.28	1.20	1.13	1.05	0.97	0.92	0.88	0.84
12			1.15	0.99	0.84	0.71	0.62	0.56	0.52	
17			1.18	1.08	0.96	0.86	0.79	0.72	0.64	0.58
Monthly means			**1.20**	**1.09**	**0.99**	**0.90**	**0.83**	**0.77**	**0.71**	**0.70**
Departure from 9-year normal			**−0.04**	**−0.04**	**−0.04**	**−0.02**	**−0.03**	**−0.05**	**−0.05**	**−0.04**

TABLE 1.—*Solar radiation intensities during February, 1917*—Continued.

Madison, Wis.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Feb. 2			1.48	1.37	1.31	1.24	1.17	1.10	1.02	
9			1.51	1.43	1.34	1.27	1.20	1.14	1.09	
10			1.52				1.23	1.16	1.10	
20		1.46	1.34	1.24	1.17	1.10	1.04	0.99	0.94	
24		1.57	1.45	1.41	1.34	1.27	1.18	1.10	1.03	0.99
27		1.57	1.45	1.40	1.33	1.27	1.21	1.14	1.09	1.03
28			1.35	1.26	1.24	1.15	1.07			
Monthly means		**1.53**	**1.44**	**1.35**	**1.29**	**1.22**	**1.16**	**1.10**	**1.04**	**(1.01)**
Departure from 7-year normal		**+0.01**	**+0.06**	**+0.04**	**+0.05**	**+0.01**	**+0.01**	**+0.07**	**+0.07**	**+0.05**
P. M.										
Feb. 2			1.42	1.37	1.29					
8			1.51	1.46						
9			1.55	1.44	1.33	1.23				
10			1.52	1.41	1.32	1.22				
17			1.47	1.37	1.29	1.21				
20			1.34							
21								1.05	0.99	
24			1.49	1.38						
27			1.47	1.38	1.29	1.20	1.14			
Monthly means			**1.47**	**1.40**	**1.30**	**1.22**	**(1.14)**	**(1.05)**	**(0.99)**	
Departure from 7-year normal			**+0.07**	**+0.08**	**+0.07**	**+0.05**	**+0.02**	**−0.16**	**−0.05**	

Lincoln, Nebr.

A. M.										
Feb. 1			1.65	1.55	1.46	1.37	1.29		1.19	
2			1.61	1.52	1.43	1.34	1.25	1.19	1.13	
8			1.58	1.48	1.36	1.27				
16		1.49	1.40	1.32	1.24					
23		1.58	1.41							
26		1.44								
Monthly means		**1.50**	**1.53**	**1.47**	**1.37**	**1.33**	**(1.27)**	**(1.19)**	**(1.16)**	
Departure from 2-year normal		**+0.02**	**+0.06**	**+0.12**	**+0.09**	**+0.17**	**+0.18**	**+0.17**	**+0.08**	
P. M.										
Feb. 1			1.61	1.51	1.43	1.35	1.28	1.21	1.14	1.08
10			1.50	1.45	1.40	1.32	1.26	1.21	1.16	
15				1.37						
Monthly means			**(1.56)**	**1.44**	**(1.42)**	**(1.34)**	**(1.27)**	**(1.21)**	**(1.15)**	**(1.08)**
Departure from 2-year normal			**+0.13**	**+0.07**	**+0.10**	**+0.13**	**+0.15**	**+0.07**	**+0.15**	**+0.24**

TABLE 1.—*Solar radiation intensities during February, 1917*—Continued.

Santa Fe, N. Mex.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Feb. 1	.....	.....	1.64	1.57	1.49	1.42	1.36	.....	.....	.....
5	.....	.....	1.47	.....	.....	1.32	1.27	.....	.....	.....
8	.....	1.55	1.50	1.44	1.38	1.26	.....	.....	.....	.....
9	.....	1.61	.....	.....	.....	1.36	1.29	.....	.....	.....
13	.....	.....	.....	1.44	1.37	1.30	1.24	.....	.....	.....
16	.....	.....	1.49	1.39	1.31	.....	.....	.....	.....	.....
Monthly means	.....	(1.58)	1.52	1.46	1.39	1.33	1.29	.....	.....	.....
Departure from 5-year normal	.....	±0.00	+0.05	+0.07	+0.08	+0.04	+0.04	.....	.....	.....
P. M.										
Feb. 8	.....	.....	1.46	1.41	1.35	.....	1.26	1.16	1.08	.....
Monthly means	.....	.....	(1.46)	(1.41)	(1.35)	.....	(1.26)	(1.16)	1.08)	.....

Table 2 shows very low vapor pressures at the above stations on the days when these high readings were obtained.

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	p.m.
1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*
Feb. 1	8.81	2.16	Feb. 2	0.20	0.46	Feb. 1	0.23	0.33	Feb. 1	1.19	1.02
2	1.02	0.86	8	1.96	0.53	2	0.23	0.53	5	1.60	2.62
3	0.51	0.97	9	0.48	0.71	8	1.78	1.24	8	2.16	2.26
5	0.66	0.58	10	0.48	0.71	10	1.78	1.78	9	2.06	2.16
6	1.12	1.78	17	3.81	1.37	15	3.45	3.15	13	2.36	3.63
10	0.71	0.97	20	1.02	1.32	16	3.15	3.99	16	1.78	2.36
12	0.81	0.64	21	2.26	1.45	23	0.97	1.37	.....	.....	.....
13	0.56	1.45	24	0.86	1.07	26	3.15	1.78	.....	.....	.....
17	3.63	4.17	27	0.86	1.24	.....	.....	.....	.....	.....	.....
.....	.....	.....	28	1.32	1.78	.....	.....	.....	.....	.....	.....

Table 3 shows about the normal amount of radiation for the month at Washington and Lincoln, and an excess of about 17 per cent at Madison.

TABLE 3.—*Daily totals and departures of solar and sky radiation during February, 1917.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
	calories.	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*
Feb. 1	206	320	351	0	115	97	0	115	97
2	294	325	303	86	117	46	86	232	143
3	359	280	258	148	70	−2	234	302	141
4	296	270	211	83	57	−52	317	359	89
5	326	306	267	111	90	1	428	449	90
6	362	235	155	144	16	−115	572	465	−25
7	231	263	294	9	40	21	581	505	−4
8	144	336	280	−81	110	4	500	615	0
9	154	354	142	−74	125	−138	426	740	−138
10	373	359	336	142	126	53	568	866	−85
11	361	360	328	127	124	42	695	990	−43
12	332	271	227	94	32	−63	789	1,022	−106
13	340	177	193	99	−66	−100	888	956	−206
14	278	262	309	34	16	13	922	972	−193
15	28	115	231	−219	−134	−68	703	838	−261
16	149	320	328	−102	67	26	601	905	−235
17	309	347	341	55	91	36	656	996	−199
18	116	308	198	−141	49	−110	515	1,045	−309
19	99	85	298	−161	−178	−13	354	867	−322
20	67	394	342	−197	128	28	157	995	−294
Decade departure							−411	129	−209
21	245	220	371	−22	−49	54	135	946	−240
22	381	267	292	111	−6	−28	246	940	−268
23	142	311	368	−132	35	45	114	975	−223
24	270	402	306	−7	123	−20	107	1,038	−243
25	372	195	335	92	−87	7	199	1,011	−236
26	196	278	341	−88	−8	10	111	1,038	−226
27	182	409	355	−106	119	21	5	1,122	−205
28	26	378	335	−266	85	−2	−261	1,207	−207
Decade departure							−418	212	87
Excess or deficiency since first of year.	calories.						−793	+2,085	−407
	Per cent.						−6.4	+17.3	−2.8

In Table 4 the high value of the solar constant obtained from the A. M. measurements of February 1 at Lincoln is probably due to the presence of local smoke during the morning, and its passing away before noon. Likewise, the low value of the solar constant obtained from the A. M. measurements of February 8 at Santa Fe is probably due to the effect of local smoke. It will be noted that in general the solar constant values obtained are slightly higher than Abbot's average value.

TABLE 4.—*Solar radiation intensities for zenithal sun reduced to mean solar distance of the earth, and approximate values of the solar constant.*

[Gram-calories per minute per square centimeter of normal surface.]

Station.	Date.	Radiation intensity.		Solar constant.
		m = 1	m = 0	
	1917.	*calories.*	*calories.*	*calories.*
Washington, D. C.	Feb. 6, a. m. and p. m.	1.54	1.80	1.88
	10, a. m.	1.51	1.84	1.91
Madison, Wis.	Feb. 2, a. m.	1.62	1.82	1.88
	9, a. m.	1.71	1.92	1.98
	17, p. m.	1.63	1.85	1.95
	27, p. m.	1.65	1.88	1.95
Lincoln, Nebr.	Feb. 1, a. m.	1.86	2.06	2.12
	1, p. m.	1.75	1.95	2.01
	2, a. m.	1.75	1.98	2.04
	10, p. m.	1.64	1.81	1.89
Santa Fe, N. Mex.	Feb. 1, a. m.	1.75	1.92	1.99
	8, a. m.	1.57	1.70	1.78

Skylight polarization measurements made at Washington on four days when there was no snow on the ground give an average of 65 per cent, and a maximum of 69 per cent on the 10th. These are about average values for Washington for February.

ERRATUM.

In the MONTHLY WEATHER REVIEW for November, 1916, p. 615, column 2, the equation for computing the sun's hour angle from the meridian *should read*

$$\cos h = \frac{\sin a - \sin \phi \sin \delta}{\cos \phi \cos \delta}$$

This correction should also be made where this equation occurs in the reprint of the article, viz, at the bottom of page 6.

THE SMOKE CLOUD AND THE HIGH HAZE OF 1916.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Weather Bureau, Washington, D. C., Mar. 27, 1917.]

Description of the smoke cloud.

During the last four or five days in July, 1916, a dense cloud of smoke overspread eastern New York and the New England States. Apparently it was first observed in northeastern New York on July 27, but its maximum effect appears to have been observed in northern New England on July 30. This day was described as "dark" at Gardiner and Eastport, Me., and Westboro, Mass., and as "yellow" at three Weather Bureau stations in Maine, four in New Hampshire, two in Vermont, and one each in Massachusetts, Rhode Island, and Connecticut.

During this same period smoke, mostly from forest fires, was recorded at many stations in Michigan, and haze or smoke, but usually haze, was recorded at a few stations

in Ohio, Kentucky, Indiana, Illinois, Wisconsin, Iowa, and Nebraska. It was not recorded in Tennessee, Missouri, Colorado, or Wyoming.

In western New York, in New Jersey, and in Pennsylvania smoke or haze was quite generally recorded on July 28–31; in Maryland, Virginia, West Virginia, North Carolina, and South Carolina on July 29–31; and in Georgia on August 1–3. South of Virginia the records generally read "haze."

The brilliant twilight colors of July 30–31, 1916.

Near the outer edge of the smoke cloud brilliant twilight colors, usually red, were recorded on July 30 or 31, at the following stations:

Westboro, Mass.; Providence, R. I.; Hartford and New Haven, Conn.; Ithaca and Binghamton, N. Y.; Plainfield, N. J.; Lewisburg, Pa.; Baltimore, Easton, and Fallston, Md.; Washington, D. C.; Richmond and University, Va.; Elkins and Piedmont, W. Va.; McConnelsville, Ohio; Lansing, Mich.; and Keokuk, Iowa.

Cause of the smoke cloud.

This smoke cloud undoubtedly came from forest fires in Ontario, Canada, respecting which the director of the Canadian Meteorological Service writes as follows:

> Forest fires became rather prevalent in northern Ontario after July 20, and on July 29 and 30 a fire of unusual dimensions and fury swept over a tract of country about 60 miles square centered about lat. 48° 45′ N. and long. 81° W.
>
> The smoke became very dense in the Canadian Maritime Provinces on the 30th, and that date is there spoken of as the "dark day." On the evening of that day I received a telegram from a judge at St. Andrews, New Brunswick, asking for an explanation of the extraordinary phenomenon. It appears probable to me that with the exceeding great intensity of this fire the smoke may have reached higher atmospheric levels than is usual in more moderate fires.

Observations of the high smoke or haze of July–August, 1916.

Outside of New England and eastern New York, where the smoke cloud was densest, a high haze of unusual character was quite generally observed, apparently drifting westward. Thus it was recorded at a few stations in Alabama, Mississippi, and Louisiana from July 31 to August 2; in Texas from July 30 to August 4; at Roswell, N. Mex., from August 2 to 4; in Arizona from August 4 to 7; and in southern California from August 2 to 9. The following extracts from observers' notes will make clear the character of this haze:

Madison, Wis., July 27–29.—Haze so thick it was possible to look at the sun an hour or more before sunset.

Lincoln, Nebr., July 26.—Pyrheliometric readings discontinued at 8:09 a. m. on account of haze. Only about 2/10 Cu. clouds, but sky a pale yellow in the direction of the sun. The haze was visible as a gray cloud bank around the horizon to a height of 30°. The remainder of the sky was of a grayish blue tint, with haze discernible as very light cirrus cloud forms.

Haze was also observed at Lincoln on the 27th, 28th, 29th, and 31st, and on August 2–4.

At the *Aerological station, Drexel, Nebr.*, about 50 miles northwest of Lincoln, no record of haze was made except the following on August 4: Very thin veil of cirrus haze visible at times in portions of sky from 11 a. m. to 7 p. m.

Highlands, N. J., July 30.—A dense haze rather than clouds.

Richmond, Va., July 31.—The elevated stratum of smoke continued throughout the entire day, and together with some A. Cu. clouds was sufficient to prevent a record of sunshine. The disk of the sun was faintly visible during a considerable portion of the day, but the light was not strong enough to cast a shadow.

Lexington, Ky.—Dense haze prevailed from p. m. of July 30 to a. m. of July 31, when it became light, and continued throughout the day. Except for its density, and its apparent extent to a great height, it was not remarkable. It was the only dense haze that occurred during 1916.

Special weight should be given the following notes which were made at *Raleigh, N. C.*, by Assistant Observer Thomas R. Brooks, who had observed the dense haze of June, 1912, at Mount Weather, Va., and states that he was impressed with the similarity in the appearance of this latter haze to that of the haze of 1912.

July 31.—The sky was overcast during the day by a heavy veil ranging in color from a bluish white near the zenith to a dull gray at the horizon. This was carefully examined to determine whether it consisted of cloud or haze. During the greater part of the day it was uniform throughout, exhibiting no irregularities of color or texture except the gradual and natural change from zenith to horizon. In the late afternoon, however, the sky near the sun became mottled in appearance and the vague outlines of clouds were seen within the immediate vicinity of the sun. The sun shone faintly all day and it was noticed that shadows were fringed with a reddish tint and that sunlight streaming into a darkened hallway was tinged with a reddish color.

Anniston, Ala.—Haze was recorded from July 31 to August 2. On the afternoon of the 31st the haze was light, with increasing upper clouds. Only the red rays penetrated the haze and clouds, and the sun was seen as a red disk.

Meridian, Miss., Aug. 1–2.—Cirrus haze caused the sunlight to be dim.

San Antonio, Tex., Aug. 3.—Dense haze; sun nearly obscured at sunset.

Abilene, Tex., Aug. 4.—Haze dense enough to practically obscure cirrus or cirro-stratus clouds.

Mount Wilson, Cal.—From notes kindly furnished by Mr. C. G. Abbot, director of the astrophysical observatory, Smithsonian Institution, it appears that the presence of cirrus clouds toward the end of July somewhat masked the effect of haze; but there is evidence of its presence at intervals after the 19th, probably increasing in density to about August 7, on which date the following note was made: "Sky streaked and fluted much like volcanic sky;" and on August 8, "Sky like yesterday; worse in morning, somewhat better in the afternoon." The notes indicate decreasing haziness until about August 29, after which date it was scarcely noticeable. The sky was generally described as *milky*, or *streaky* near the horizon in the direction of the sun.

A note on the decrease in solar radiation intensities at Washington, D. C., Madison, Wis., and Lincoln, Nebr., due to this haze, will be found in the REVIEW for July, 1916, **44**:382; and a description of the remarkable haze observed at Roswell, N. Mex., on August 2–4, will be found in the REVIEW for October, 1916, **44**:550.

Meteorological conditions accompanying the haze and smoke.

From July 27–31 an area of high pressure (No. VIII on Chart II, "Tracks of Centers of High Areas," MONTHLY WEATHER REVIEW, July, 1916) advanced from Quebec to the Maine coast, and thence southwestward to Alabama. During this period there was considerable cloudiness in the Atlantic Coast States, and especially along the New England coast; but the 29th was generally clear north of Virginia, and the 30th was clear from southern New England to Georgia. The winds were generally light and variable. From the 27th to the 30th clear weather with southerly winds and high temperatures prevailed over the Central States.

On August 1, from an area of high pressure central over the Great Lakes (No. I on Chart II, "Tracks of Centers of High Areas," this REVIEW, August, 1916) a ridge of high pressure extended southwestward into Texas. The extremity of this ridge became separated

from the main area, and persisted as a secondary HIGH, with a slow westerly drift, until it disappeared over Colorado on August 4.

From the above it will be seen that the smoke and haze that covered the Atlantic Coast States at the end of July, 1916, and also the haze that extended from Texas to California early in August, was first observed in an area of high pressure, where the seeing is usually good. The haze observed at about the same time in the Ohio and Mississippi valleys, and westward to Nebraska, occurred in connection with an unusually hot and dry period, which of itself would introduce great quantities of dust into the lower atmosphere.

"Twilight-cirrus haze."

While, as stated above, the high haze was scarcely noticeable during the daytime at Mount Wilson, Cal., after the end of August, 1916, a fine cirrus-like formation was observed there at sunrise by Assistant Astronomer Wendall P. Hoge, during the months of August, September, and October.[1] He describes it as "streaks of velvety clouds that gave one the impression of a canopy of color spread overhead far to the east." Mr. Ford A. Carpenter, meteorologist, Weather Bureau, also observed these cirrus-like formations at Mount Wilson on the morning of September 4. At Tucson, Ariz., Dean A. E. Douglass, of the University of Arizona, began observing this high haze on September 16, 1916.[2] He states that "This structure usually appears as a faint soft etching of large numbers of parallel lines." From cloud shadows cast on this haze layer after sunset he computed its height to be about 12 miles (19 kilometers).

Very similar to the above is Maurer's description of the high haze observed in the Alps from the middle of July to the middle of November, 1916.[3] The following is quoted from Nature (London) for December 28, 1916, **98**:328:

> This remarkable optical deterioration of the atmosphere was visible here (Zurich) until about the middle of November. The thin, cirrus-like layer could be seen on clear mornings just before sunrise at a height of about 14–15 km. above the earth's surface, according to our reckoning; that is to say, it was situated considerably above the usual cirrus region. It consisted of thin horizontal bands, extremely delicate and soft, which soon disappeared after sunrise. A curious fact was that no appreciable effect, either actinometric or photometric, was produced by this thin, mistlike layer. The impression made was that of a most delicate, cometlike veil of mist, yet not dimming the starlight. After sunrise absolutely nothing was to be seen of the phenomenon, in spite of the keenest observation through field-glasses of a weak magnifying power. * * *
>
> During the period of maximum visibility of the thin veil (twilight-cirrus), such a conspicuous layer was to be seen in the eastern sky, shortly before sunrise and at a height of 40°, that even an unskilled observer would have noticed it at once. The structure of the layer was often so regular and definite in its remarkable horizontal stratification that it looked as though an artist with a coarse brush had colored the whole eastern sky with long horizontal strokes not too neatly laid on.

Brilliant twilight colors during the latter part of 1916.

In addition to the observations of brilliant twilight colors on July 30–31, referred to above, brilliant twilights were quite generally recorded from Texas westward to southern California during the first week in August. Thus, at El Paso, Tex., the record reads:

> Light haze about 6 a. m. August 2, and continued until the forenoon of the 6th. During this period the sun's appearance at sunrise and sunset was remarkably red, and the twilight colors gorgeous.

Descriptions of the phenomena as observed at Mount Wilson, Cal., and Tucson, Ariz., have already been published in the MONTHLY WEATHER REVIEW for November, 1916, **44**: 625–627.

These brilliant twilight colors were observed at Los Angeles, Cal., until the end of November, 1916.

Astronomer W. P. Hoge writes, under date of March 31, 1917, that at Mount Wilson, Cal.:

> The phenomenon is still in evidence every clear morning, but with greatly reduced intensity. While not conspicuous it certainly still exists. The streamers [crepuscular rays] that were so noticeable at first are no longer visible, but the soft velvety canopy far to the east can still be faintly seen.

At Tucson, Dean A. E. Douglass, under date of March 9, 1917, writes that "The cirrus-like haze and the brilliant twilight glow of last autumn have by no means disappeared, although the latter has decreased in brilliancy."

In this connection it is of interest to note that in the Journal of the Royal Astronomical Society of Canada for February, 1917, **11**: 79, Mr. A. F. Hunter states that in Canada the sunsets, and especially the afterglows, have been unusually brilliant during the past few months.

Cause of the high haze and the brilliant twilight colors.

As already stated, the smoke cloud that covered New York and New England at the end of July, 1916, undoubtedly originated in the forest fires that prevailed in Ontario, Canada. It is not possible to determine the southern or western boundary of this cloud; but there is no reason for supposing that it was in any way connected with the high haze observed from Texas westward early in August. We certainly can not suppose it to have been the cause of the high cirrus-like haze observed in Arizona and southern California from August, 1916, to March, 1917; or to have produced the brilliant twilight colors that accompanied the haze. Rather, we must attribute these latter to the same cause that produced the brilliant twilights in Canada, and the high haze observed in Switzerland.

These phenomena have been attributed to a variety of causes, such as the gases arising from the great battle fields of Europe, cosmical dust, and volcanic dust. The similarity of the high haze of 1916 to that of 1912 has been here pointed out, and Prof. Riccò has called attention to the fact that Stromboli volcano was in violent eruption early in July, 1916.[4] Unfortunately, definite data relative to the violence of the eruption, and the height to which volcanic ash was thrown into the atmosphere, is lacking. At present, however, this eruption appears to be the most probable source of the high haze of 1916. The marked diminution in its intensity at the end of the year argues against its arising from the battle fields of Europe.

Assuming this eruption to be the source, then the cirrus-like haze is probably a thin layer of fine dust that was thrown to more than the average height by an unusually violent explosion, which dust, because of the fineness of its particles, falls more slowly than the denser lower cloud that was made up of coarser particles.

Since above about 14 kilometers the wind velocity from the east increases quite rapidly with altitude, the

[1] See this REVIEW, November, 1916, 44: 626.
[2] See this REVIEW, November, 1916, 44: 625.
[3] See also: *Maurer, J.* Zur atmosphärisch-optischen Störung des Sommers 1916. Meteorol. Ztschr., Nov. 1916, 33: 515–517.
Wolf, Max. Ueber die höchsten Dämmerungswolken., ibidem, p. 517–519.
Laska, V. Abnormale Dämmerungserscheinungen im Sommer 1916, ibidem, p. 520.—EDITOR.

[4] See this REVIEW, October, 1916, 44: 550.

finer dust cloud, with its accompanying brilliant twilight colors, might well be observed in the clear atmosphere of southern California some days in advance of the denser lower cloud, and, indeed, before the latter had been observed in States farther east.

It also seems fair to assume that this volcanic dust was at least in part the cause of the high haze observed over the South Atlantic States at the end of July; and it may have been a contributing cause of the brilliant twilight colors observed on July 30–31 in the eastern part of the United States.

FREE-AIR DATA IN THE HAWAIIAN ISLANDS, JULY, 1915.

By Col. WILMOT E. ELLIS, Coast Artillery Corps, U. S. Army.

[Dated: Fort Ruger, H. T., Jan. 23. MS. received Feb. 7, 1917.]

The title of this article suggests that the usual paraphernalia of sounding balloons, captive balloons, or standard kites with self-registering instruments were utilized in making our explorations, but such was not the case. Our exploring apparatus consisted of two "home-made" kites and of cast-iron projectiles fired from 12-inch sea-coast mortars. Although our experimental firings were conducted primarily with a view to obtaining ballistical information, we incidentally obtained considerable information of interest to the aerologist. The purpose of this article is to discuss the results obtained with special reference to aerology.

Explorations of the upper air within the Tropics have been very limited in number and in the extent of the territory covered. There has been none whatever in our insular possessions.[1] Systematic exploration work has been carried on at Batavia in the Dutch East Indies. The chief of the U. S. Weather Bureau in a letter to the commanding officer, Fort Ruger, under date of September 10, 1915, states:

> A typical pilot balloon observation made by Mr. Van Bemmelen, in charge of the observatory there [Batavia], shows the trade winds to be about 3 km. deep, with a velocity of 5 m. p. s. The anti-trades extend from 3 to 17 km., their velocity increasing gradually from 5 m. p. s. at 3 km. to 23 m. p. s. at 14 km. The upper trade winds extend from 17 to 18 km., and have low velocities like the surface trades. Between the 18- and 23-km. levels, a high westerly wind, velocity 10 to 15 m. p. s., was found. Above this level, to the highest level explored, easterly winds again prevailed, reaching velocities of 40 m. p. s. in the vicinity of the 30-km. level.

In the Hawaiian Islands, the prevailing winds are the northeast trades and have a temperature of about 70°F. The relative humidity averages 65 per cent. These conditions are greatly modified by mountains and local convection currents. There are two principal ranges on the island of Oahu. The Koolau extends along the northeastern or windward side. The Waianae range is on the southwestern side. Both ranges are covered with dense vegetation. The elevation averages between 2,000 and 3,000 feet, the highest altitude being about 4,000 feet. Between the two ranges is an elevated tableland. The moisture carried by the trades is largely precipitated upon these mountains, but they are not high enough to keep the wind from sweeping over them and through the deep valleys on the leeward side. The trades are at least 4,000 feet deep, and—as will be shown later—our mortar firings indicate that they are about the same depth as the southeast trades at Batavia—approximately 10,000 feet. The trades are generally interrupted by "konas" or southerly gales, from November to the latter part of March. The konas are damp and blustering winds, warmer and more humid than the trades. As might be expected, the winds on the leeward side are—during the prevalence of the trades—more or less capricious. There is considerable diversity in wind directions well above the surface of the earth. True cirrus clouds, whose altitude ranges about 26,000 feet, are not common; but, when observed, they generally indicate a movement with an anti-trade component.

In our system of sea-coast mortar firing, we use a series of imaginary zones described about the mortar battery as a center. These zones are numbered from 1 to 9 outward, zone 1 being nearest the battery. Projectiles of three different weights are used, and the powder charge varies for each zone. The angles of elevation for each zone run from 45° to 65°, the former elevation giving the maximum range and the minimum height of trajectory, and the latter the minimum range and the maximum height of trajectory. Each zone overlaps its neighbor for a distance varying from about 500 yards to about 1,000 yards, so that a change in ammunition can always be smoothly made in firing at a target whose course involves a change in zone. Our plotting board gives us the direction and distance of the target from the battery. Range tables calculated by our ballisticians furnish us with elevations corresponding to ranges, and the drift of the projectile for the various elevations. The drift of the projectile is always to the right, increasing with the elevation. The drift is considerable, and must be allowed for in laying the mortar in direction. For example—the drift at an elevation of 65° in the 9th zone is about 1,450 yards for a time of flight of 75 seconds. In training for direction, the mortar is laid in azimuth, azimuths being reckoned from the south point clockwise through the west point. When a series of shots are fired at a fixed point, using the same elevation, azimuth, and ammunition, it rarely happens that any shot falls within a hundred yards or so of the point, owing principally to variations in the muzzle velocity and the unknown aerological conditions that the projectile encounters in its flight.

Col. Rafferty's experiments, July, 1915, at Oahu.

In February, 1915, Col. W. C. Rafferty, Coast Artillery Corps, commander of the coast defenses of Oahu (located in and near Honolulu) obtained authority from the War Department to fire a series of 74 shots from the 12-inch mortars. The purpose of the firing was:

1. To determine the drift of the 700-pound projectile in the ninth zone, and the 824-pound projectile in the eighth zone;
2. To determine the law which governs the deviation due to wind;
3. To discover any other information relating to mortar firing which may be useful to the service.

The shots were distributed between two batteries, Battery Harlow at Fort Ruger near Diamond Head Crater, and Battery Hasbrouck at Fort Kamehameha adjoining Pearl Harbor. These batteries are about 11 miles apart, the former being about 5½ miles east of Honolulu Harbor, and the latter about the same distance west thereof.

[1] See, however, *O. L. Fassig:* Kite flying in the Tropics. MONTHLY WEATHER REVIEW, Dec. 1903, **31**: 582-587, 5 figs., for an account of upper-air observations by means of kites during the expedition to the Bahamas in 1903, under the auspices of the Geographical Society of Baltimore.—EDITOR.

The following was the program:

FIRST DAY, JULY 8, 1915.

Fire 12 shots from Battery Harlow.

Shot numbers.	Zone.	Azimuth.	Elevation.
		°	°
1	8	280	55
2	8	100	55
3	8	280	55
4	8	100	55
5	8	280	55
6	8	100	55
7	9	280	55
8	9	100	55
9	9	280	55
10	9	100	55
11	9	280	55
12	9	100	55

SECOND DAY, JULY 9, 1915.

Fire 27 shots from Battery Harlow, and the same number from Battery Hasbrouck in series of nine shots, each series to be in accordance with the following table:

Shot numbers.	Zone.	Azimuth.	Elevation.
		°	°
1, 10, 19	9	315	55
2, 11, 20	8	315	55
3, 12, 21	5	315	55
4, 13, 22	9	45	55
5, 14, 23	8	45	55
6, 15, 24	5	45	55
7, 16, 25	9	0	55
8, 17, 26	8	0	55
9, 18, 27	5	0	55

Shots of the same serial number at each battery were fired as nearly simultaneously as possible.

THIRD DAY, JULY 10, 1915.

Fire 8 shots from Battery Hasbrouck.

Shot numbers.	Zone.	Azimuth.	Elevation.
		°	°
1	8	10	50
2	9	10	50
3	8	10	60
4	9	10	60
5	8	10	50
6	9	10	50
7	8	10	60
8	9	10	60

Col. W. E. Ellis, C. A. C., fort commander at Fort Ruger, was in charge of the firing at Battery Harlow, and Lieut. Col. Frank W. Coe, C. A. C., fort commander at Fort Kamehameha, was in charge of the firing at Battery Hasbrouck.

The target point for each shot was a point on the sea surface at the range-table range corresponding to the elevation, and at the prescribed azimuth. No corrections for height of site were made. Correction for tabular drift was applied to each shot.

The following aerological stations—some temporary, some permanent—were utilized:

No. 1, at Kupikipikio Point.—This Point is about 1½ miles east of Diamond Head Summit. From this station, we noted the direction of the upper wind by kite.

No. 2, at Diamond Head Summit.—At this station, we took the direction of the upper wind by kite, and the velocity of the [lower] wind as indicated by an anemometer located about 40 feet above the ground on a pole.

No. 3, U. S. Army meteorological station at Fort De Russy.—This station is on the beach, 30 feet or so above sealevel and about 2½ miles northwest of Diamond Head Summit. Here we recorded the direction and velocity of the surface wind, the thermometer, and the barometer.

No. 4, the U. S. Weather Bureau Station in Honolulu.—Same data as No. 3.

No. 5, our meteorological station at Fort Kamehameha.—This station is about 30 feet above sealevel. Same data as No. 3.

The kites used were designed by the Coast Defense commander. They were flown to an altitude of about 800 feet above the surface of the earth. The station at Kupikipikio Point is 122 feet above M. L. W., and the one at Diamond Head Summit, 765 feet above M. L. W. The kites, therefore, indicated wind directions about 900 feet and 1,600 feet above sealevel, respectively.

On July 8, the firing began at 6:09 a. m. and ended at 7:55 a. m. The data obtained from the U. S. Weather Bureau station during this period were as follows: Wind E, 4 miles per hour; temperature 74° to 78°F; barometer 30.05 to 30.07 inches.

On July 9, the firing began at 8 a. m. and ended at 1:48 p. m. U. S. Weather Bureau data: From 8 a. m. to 10 a. m., wind S, increasing from 4 to 9 miles per hour; from 10 a. m. to 1:48 p. m., wind E, varying between 9 to 11 miles per hour; temperature 78° rising to 84° ending at 81°; barometer 30.02 to 29.93 inches.

On July 10, the firing began at 8:04 a. m. and ended at 8:39 a. m. U. S. Weather Bureau data: Wind E, 7 miles per hour; temperature 79° to 80°; barometer 29.96 to 29.95 inches.

The essential data for the zones and elevations used are as follows:

Zone.	Zone limits.	Weight of projectile.	Elevation.	Range.	Maximum height of trajectory.
	Yards.	*Pounds.*	°	*Yards.*	*Yards.*
5	4,455-5,976	1,046	55	5,580	2,265
8	8,694-12,150	824	50	11,920	4,251
8	8,694-12,150	824	55	11,255	4,992
8	8,694-12,150	824	60	10,173	5,706
9	10,854-15,291	700	50	15,000	5,047
9	10,854-15,291	700	55	14,115	5,928
9	10,854-15,291	700	60	12,700	6,774

Ballisticians in general, and ours in particular, make the following basic assumptions regarding aerology and wind effects:

(1) Aerological conditions at a given time are regarded as constant over the range and may be obtained from instruments at or near the battery firing.

(2) Irrespective of wind conditions, a definite law connects the fall of temperature and barometer with height above the earth's surface.

(3) A wind—arbitrararily assumed constant over the range—may be divided into two components, one parallel to the line of fire, and the other perpendicular thereto; and each component may be separately considered as regards deviating effects.

Modern researches in aerology have demonstrated the fallacy of the first two assumptions.

To illustrate the third assumption: Suppose a projectile were moving into an oblique head wind of 16 miles per hour, making an angle of 45° with the line of fire. The assumption is made that the retarding effect of the wind is the same as that of a direct head wind of 12 miles; and that the lateral effect is the same as that of a 12-mile wind blowing directly across the range. This assumption, for obvious reasons, has never been tested experimentally, but it carries two fallacies and hence is inherently incorrect. In the first place, the law of the parallelogram of forces assumes the same point of application, which is not the case in the problem we are considering. In the second place, the deviating effect of a 12-mile range wind and that of a 12-mile cross wind are in general different as calculated by ballistical methods, for the formulas used are independent. Yet a little consideration shows that whatever effect the wind may have upon the projectile, *it must move with the wind;* and hence, the deviations longitudinal and lateral—in this case—must be the same. Or otherwise; the longitudinal and lateral deviations must, when compounded, indicate the resultant effect of the wind both as to amount and direction. No wind formulas that have ever come to the writer's notice take this obvious fact into consideration.

It is difficult to explain why these untenable hypotheses have been made by ballisticians, unless it be that their zeal in applying mathematical formulas to a problem that does not admit of an exact mathematical solution has misled them. In any event, one can charge this trio of fallacies with being *one* of the contributing causes to the inaccuracy of coast artillery fire. The other causes, being beyond the scope of aerology, will not be discussed in this paper.

Conclusions.

The present writer collected all available data and made a special study of the Oahu experimental firings. A brief synopsis, in so far as wind phenomena are concerned, follows.

After consideration of the Batavia data, and of the results of the experiments conducted by the U. S. Weather Bureau at Avalon, Cal., the following tentative hypothesis was formulated:

(1) The winds of the trophosphere are arranged in strata. The elements—velocity, direction, and depth—of each stratum are variable, and the elements of any one stratum are not definitely connected by any ascertainable law with the elements of any other stratum.

(2) A variation in the elements of any stratum involves or indicates an undeterminable variation in the other strata.

(3) The wind effect upon a given projectile varies indeterminately with the elevation, because, as the elevation changes, the number of strata traversed, and the time the projectile is subject to the wind effect in any given stratum, vary.

(4) The conception of a "resultant wind," or of a "mean motion of the atmosphere," is inconsistent with the hypothesis of variable wind strata.

(5) The resultant *effect* of the wind—both as to direction and amount—corresponding to a given elevation may be deduced from firing at two or more target points; but the data so obtained are of little or no value for calculating the effect at any other elevation; or, for that matter, at the same elevation, after stratum conditions have materially changed.

Based upon these hypotheses, certain formulas were deduced, which it will not be necessary to elaborate. Briefly, the problem involves four unknown quantities: (1) The variation in range due to causes other than wind; (2) the error or variation in the calculated drift; (3) the maximum resultant effect of the wind strata passed through; and (4) the direction of the resultant effect. Two target points—each giving a plotted range deviation and lateral deviation—afford the data for determining the unknowns, and three target points afford the data for independent checks. Unfortunately, our powder was not uniform and therefore the number of independent checks was quite limited.

Table 1 summarizes the results obtained.

TABLE 1.

Battery.	Zone.	Elevation.	Date.	*W.*[1]	*Az.W.*[2]	*Az. K.W.*[3]
		°	1915.	*Yards.*	°	°
Harlow	8	55	July 8	124	101	80
Harlow	5	55	July 9	90	94	89
Hasbrouck	5	55	July 9	60	94	89
Harlow	8	55	July 9	146	112	91
Hasbrouck	8	55	July 9	222	106	91
Harlow	9	55	July 9	160	108	94
Hasbrouck	9	55	July 9	131	112	94

[1] *W* is the resultant effect of the wind in yards.
[2] *Az.W.*, azimuth of same, or azimuth of that line of fire which would give the maximum increase of the range due to wind.
[3] *Az. K.W.*, azimuth *toward* which the free surface wind was blowing, as indicated by the kite flown from the summit of Diamond Head.

Firings in the ninth zone, July 8, did not furnish sufficient data to calculate *W* and *Az.W.*

Table 1 warrants the following conclusions:

(1) During the firings, the free surface wind was about east.

(2) The resultant effect of the wind corresponded quite closely in direction with the free surface wind, although there are indications that in the upper strata reached by the projectiles, southwesterly winds were encountered. This is shown by an increase of azimuth of *W* over *K.W.* and a value of *W* less in the ninth zone than in the eighth zone.

(3) Free winds along and offshore are quite uniform. The two batteries were, as stated, 11 miles apart; yet the values of *Az.W.* show a remarkable agreement. The values of *W*, except for the eighth zone, also agree quite closely.

The following supplementary table shows the results of the third day's firing at Hasbrouck. They were not incorporated in Table 1, because exact data for calculation were insufficient. Hence, the results are only approximate; but they have not been rejected, because they are so anomalous as to merit investigation, even on an approximate basis.

TABLE 2.

Battery.	Zone.	Elevation.	Date.	*W.*	*Az.W.*	*Az.K.W.*
		°	1915.		°	°
Hasbrouck	8	50	July 10	239	131	93
Do	8	60	...do.....	127	105	96
Do	9	50	...do.....	399	162	93
Do	9	60	...do.....	190	125	96

The indications are that on the morning of July 10, the surface Trades were quite shallow and that, as the projectile ascended, it encountered first southeasterly winds; and then, later, strong northwesterly winds.

Other conclusions—not deducible from the above tables—are:

The winds close to the surface of the earth showed considerable variation at different points along and on shore,

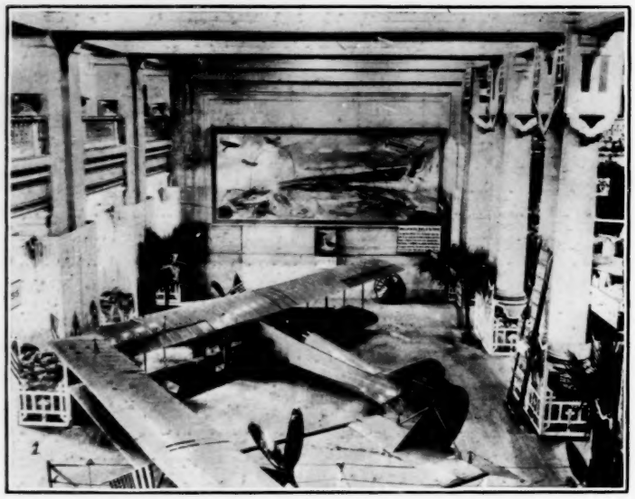


Fig. 1.—View of part of first-floor exhibit. Imaginary wall decoration at back.

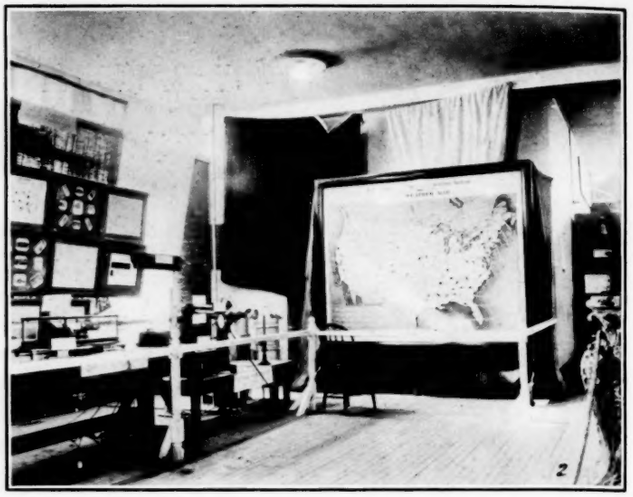


Fig. 2.—Corner of Weather Bureau exhibit, showing glass map and the regular station instruments (at left).

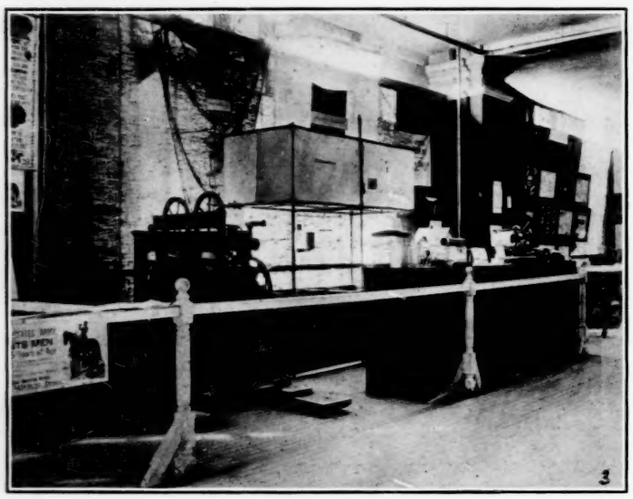


Fig. 3.—General view of Weather Bureau's aerological exhibit.

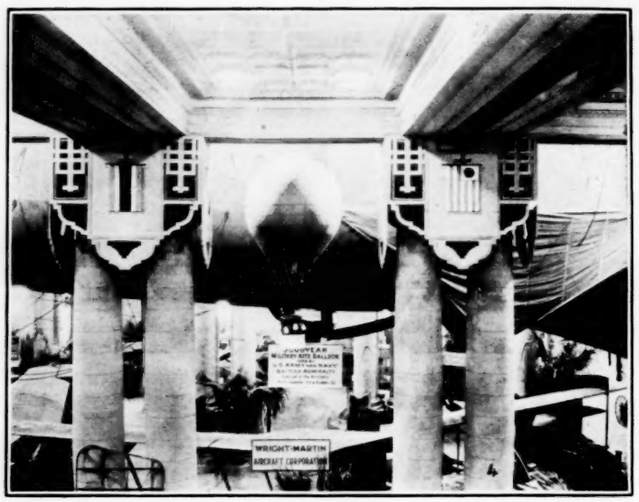


Fig. 4.—View of part of first-floor exhibit.

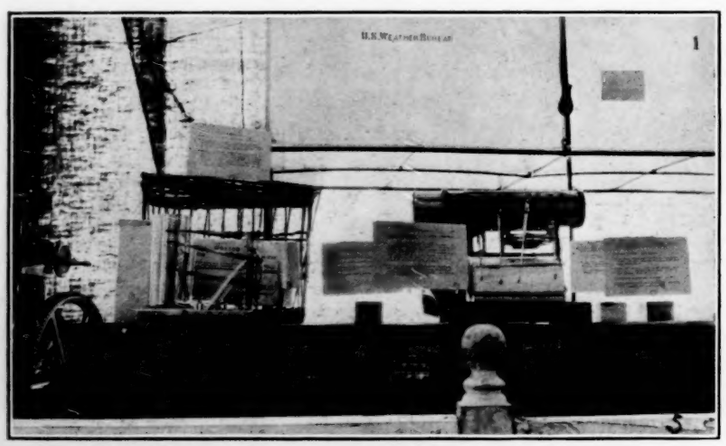


Fig. 5.—Detail views of Bosch balloon meteorograph (left) and modified Marvin kite meteorograph (right), exhibited by the Weather Bureau.

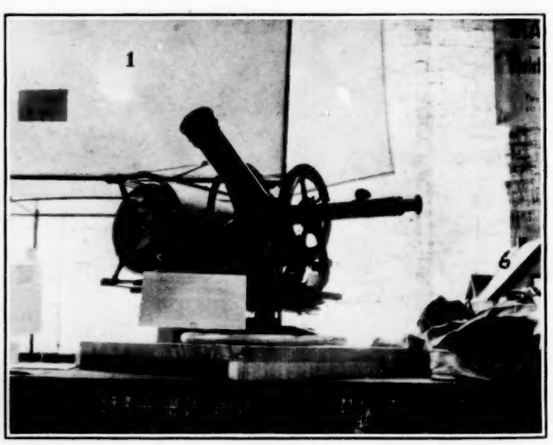


Fig. 6.—Detail view of the Blair recording balloon theodolite, exhibited by the Weather Bureau.

and such winds did not, as a rule, correspond at all with the "kite winds." Wind data taken on shore and near the earth—say within 100 feet or so—are utterly at variance with those obtained in the "free air" above the surface of the sea. Hence, empirical formulas based upon surface data are worthless.

The velocity of the wind as indicated on the summit of Diamond Head was from two to three times as great as that indicated at the United States Weather Bureau station in Honolulu.

Ballisticians have arbitrarily assumed that the drift of the projectile is independent of wind conditions, whereas a little a priori reasoning would have shown the fallacy of this assumption. But, be this as it may, our firings proved conclusively that the drift did vary with changes in wind conditions.

All who have followed this discussion will undoubtedly agree that the coast artilleryman attempting to hit a moving target at sea has a pretty problem to solve, considering that his accuracy of fire depends upon unknown aerological conditions, unknown variations in drift, and unknown changes in the muzzle velocity of the powder employed.

WEATHER BUREAU EXHIBIT AT THE FIRST PAN AMERICAN AERONAUTIC EXPOSITION.

By WILLIS RAY GREGG, Meteorologist.

[Aerological Investigations, Weather Bureau, Mar. 14, 1917.]

The First Pan American Aeronautic Exposition was held in the Grand Central Palace, New York City, February 8 to 15, 1917. The purpose of this exposition was to stimulate general interest in aeronautics by means of exhibits and to promote the more rapid advancement of this science by means of addresses and discussions. The latter were given each day in the Convention Hall and were illustrated by lantern slides and motion pictures. Of considerable interest among these was the Weather Bureau's motion-picture illustration of meteorological kite flying at the Drexel Aerological Station.

The exhibits occupied the two lower floors of the palace. Those on the first floor consisted, for the most part, of different types of aeroplanes, an interesting feature being the first motor-driven machine, in which the Wright brothers made a successful flight at Kitty Hawk, N. C., in 1903. In the open court above the first floor were suspended a large military kite balloon and a model of a manned free balloon. These and some other details of the first-floor exhibit are shown in figures 1 and 4.

On the second, or mezzanine, floor were shown models of aeroplanes and dirigibles, various types of motors and some of the later designs of propellers. There were also exhibits, consisting principally of pamphlets for distribution, by the Pan American Union, the National Security League, and the National Advisory Committee for Aeronautics. A part of this floor was devoted to exhibits by some of the Government departments, including the Bureau of Standards, Coast and Geodetic Survey, Army and Navy, Postal Service, and the Weather Bureau.

The Weather Bureau exhibit consisted of most of the instrumental equipment usually shown at expositions and, in addition, some of the instruments, apparatus, etc., used by the Aerological Division. The usual exhibit has already been described in previous numbers of the MONTHLY WEATHER REVIEW. (Vol. 43, p. 452, and vol. 44, p. 459.) Besides these instruments there was also shown a Robinson anemometer so modified that electric contact is made for each one-sixtieth of a mile of wind blown, thus enabling the observer to determine the current hourly velocity by merely counting the number of contacts made in one minute (see this REVIEW, 44:288). An electric fan operated this anemometer; also one connected in the usual way with the triple register. The latter and a barograph and thermograph were kept continuously recording. Much interest was shown in these instruments and in the glass weather map, which showed the weather conditions and the forecast for each day. The general arrangement and appearance of this part of the Weather Bureau exhibit are shown in figure 2. A large number of descriptive pamphlets on "The Weather Bureau" and "Explanation of the Weather Map"; also cards explaining the flags used for warnings were distributed during the exposition.

The aerological exhibit included a kite, kite reel, recording theodolite, 2 kite meteorographs, 1 balloon meteorograph, piece of sounding balloon rubber, a number of free air records obtained by means of kites, captive and sounding balloons, and copies of the Mount Weather Bulletin and Monthly Weather Review containing summaries of free air work. Figure 3 shows the kite, with meteorograph attached, kite reel and some of the instruments; in figures 5 and 6 the instruments can be seen in somewhat greater detail. All of this apparatus has been in regular use by the Weather Bureau, except the recording theodolite which is of recent design and construction. Its use in pilot or sounding balloon work will require but one observer, whereas, with the nonrecording theodolite, it has been necessary to have two observers; one to keep the balloon on the cross hairs, the other to record the angular readings. Much interest was shown in these instruments and in the piece of sounding balloon rubber, it being pointed out that all of our pure rubber balloons have been obtained from Europe and that no satisfactory samples have yet been produced in this country.

Greatest interest was apparent in the meteorograph records, which were briefly described on attached cards, and in the summaries of free-air data. It was evident that comparatively few of those actively engaged in aviation are aware of the existence of tables and charts showing temperature and wind conditions at various levels and under different conditions of pressure distribution at the earth's surface. The direct bearing and value of this work to aviators was emphasized, with the result that there were numerous requests for the summaries already published and for all publications along this line that may be issued in the future.

SOUND AREAS OF THE EXPLOSION AT EAST LONDON, JANUARY 19, 1917.[1]

By CHARLES DAVISON.

It is not often that a great explosion occurs near the center of a populous area, and the recent disaster in East London, England, thus offers an opportunity of adding to our knowledge on the transmission of sound waves by the atmosphere. * * * The most remarkable result [of recent investigations in this subject] is the recognition of the fact that there exists sometimes, not always, a zone of silence which separates two detached sound areas. This zone has been traced in 20 recent explosions (excluding that of Friday, January 19), two

[1] *Condensed from* Nature, London, Feb. 1, 1917, 98: 438-439, by W. G. Reed.

being due to gun-firing, four to explosions of dynamite or gunpowder, and the remainder to volcanic explosions in Japan.[2]

The source of sound is always unsymmetrically placed within the inner sound area, and nearly always lies on the side facing the outer sound area. On this side the boundary of the inner area may be as near as 2½ miles, or as distant as 39 miles, from the source. The most important dimension, however, is the radius or mean radius of the curve that forms the outer boundary of the zone of silence. It is far from being constant. It may be as low as 50 miles, as in the case of the minute-guns fired at Spithead on February 1, 1901, or as high as 99 miles, as with the Wiener-Neustadt explosion of 1912. * * *

Though later accounts may modify some of the dimensions given below, a first analysis of the reports already received shows that the explosion at East London on January 19, 1917, belongs to the class with double sound areas. *The inner sound area* is of unusual form, being L-shaped with the angle near Godalming, the east-west limb reaching to Canterbury, and the north-south limb reaching to the neighborhood of Northampton. The least distance of the boundary of the inner area from the source of sound is about 12 miles, and the greatest distance is 65 miles.

The outer sound area lies to the north of the other, with its center a few miles west of King's Lynn. Its longer axis, 131 miles in length, reaches from the neighborhood of Nottingham to that of Lowestoft and is about 55 miles in width. *The zone of silence* varies in width from 16 miles (near Northampton) to 54 miles, and the distance of its outer boundary from the source is about 60 miles. So far as is known at present it includes the greater part of Essex and Suffolk, the southern half of the counties of Cambridge and Huntingdon, and the central portion of Northamptonshire. Even if observations should be received afterwards from this area, it is significant that from the inner sound area of about 3,500 square miles there have so far been received 250 records in which the time is given, from the outer sound area of about 5,700 square miles 223 records (including 122 from Norfolk and 56 from Lincolnshire), and from the zone of silence of about 4,500 square miles only one record and that one close to the sea. The greatest distance to which the sound waves penetrated is about 121 miles.

A remarkable feature about these records is that, although all have been sent in reply to my newspaper letters (and therefore sent as it were at random), they are almost as thickly grouped near the boundaries as near the centers of the two areas. There is none of that increasing sparseness of records near the boundary which is so characteristic of earthquake investigations. It would seem as if the boundary were determined, not by the sound vibrations becoming inaudible, but by the absence of sound vibrations from the area beyond. It may be of interest to add that, at a large number of places, pheasants showed signs of alarm as they did during the North Sea battle of January 24, 1915. * * *

[2] *Fujiwhara, S.* On the abnormal propagation of sound waves in the atmosphere. *Abstracted in* MONTHLY WEATHER REVIEW, May, 1914, 42:258–265 [bibliography] and August, 1916, 44:436–439 [illust.].

PARHELIC CIRCLE WITH TWO PAIRS OF PARHELIA AT FARGO, N. DAK.

C. L. Meller, writing to the Scientific American (issue for Mar. 24, 1917, p. 305) from Fargo, N. Dak., reports the occurrence at that place on December 28, 1916, of a complete parhelic circle accompanied by the colored parhelia of 22°(?) and also by what appear to have been the faintly colored parhelia of 46°. The essential portions of his description follow:

> It was Thursday noon, the weather a few degrees above 0°F., * * * the thermometer began to drop * * *. At each side of the sun a sun dog stood, a condensed little rainbow with the red toward the sun, showing but little curvature and not a great many times longer than it was wide, with no great width at that. * * * A narrow band of light, readily visible, still not without a certain quality of faintness, * * * stretched from one sun dog to the other, not overhead but to the north, and no higher than the sun stood to the south. Twice the distance that each sun dog was from the sun this ring of light widened into an irregular disk of light that seemed each a second sun dog with the colors so faint that the eye could only discern them as a faint white light. * * * The sun dogs rose with the sun and stood with the sun until 3 o'clock in the afternoon, but the ring lasted only from about 11 till a little past noon.

It is unfortunate that the observer did not determine the angular positions of these parhelia on the parhelic circle; and it would also be interesting to know if the anthelion certainly did not form on this occasion.—C. A. jr.

SECTION II.—GENERAL METEOROLOGY.

COMPETENCY OF WIND IN LAND DEPLETION.

By CHARLES ROLLIN KEYES, Ph. D.

[Dated: 944 Fifth Avenue, Des Moines, Iowa, Mar. 10, 1917.]

The goal of all geological forces of land sculpturing is the perfect planation of all those parts of the lithosphere that project above the surface of the oceans. Of the three titanic powers of erosion ever at work leveling and lowering the face of the earth the wind receives least and last attention. Yet, as an agent of general denudation, the wind is actually not only more vigorous than any of the others but it is perhaps on the whole more competent than all others combined.

In the first half of the nineteenth century scientists considered the sea to be all-powerful in leveling off the lands. From his home in the British Isles Andrew Crombie Ramsay (*b.* 1814) could look out over the never-still waters and see all around him the ocean ceaselessly gnawing into the coasts and forming just beneath the water surface a broad smooth rock shelf. In fancy he could discern in the even sky-lines of his island former rock shelves that had long since been elevated above the reach of the waves. Projecting his virile mind into the future he could reckon the time when all England would be again planed off to sealevel and covered by universal waters. As a result of his musings there burst forth his great "planation theory of marine denudation."

When a generation later our own J. W. Powell (*b.* 1834), advancing a "theory of a base-level of erosion," gave expression to one of the half dozen great and brilliant geologic concepts of his century, the wearing down of the lands to sea surface was pictured as being accomplished alone by the corrading action of rivers. With the development of a definite erosion cycle through which all land forms must pass until they finally fade away to an even plain lying but slightly above tide-level, stream corrasion was extended to every land of Earth. All other agents of general land leveling and lowering were rigorously excluded.

Peneplanation is, then, a stern reality. It takes place whether or not running waters are present. Amidst waterless wastes general leveling and lowering of the lands plainly continues to go on as vigorously as in pluvial regions, but without appreciable aid from streams. That in countries of excessive dryness there should be recognized an erosive power more constant than the washings of the rains, more extensive and persistent than the encroachments of the sea is one of the recent novelties in geological science. Such power is eolian. Both as a sculpturing tool and as a sedimentative agent the wind is thus in every way the counterpart of river and ocean.

The idea of the competency of the wind to perform great regional erosion, work formerly believed to be only possible for stream and sea, is yet too new confidently to ascribe its origin to any one mind. Fifty years hence we may be better able to get proper perspective. Sure it is, however, that the specific fitting of wind work to geographic cycle is distinctly an American achievement. Whether first definitely outlined by a New World traveler on the Girghiz steppes, by a German on the South African veldt, or by a Yankee on the Mexican tableland, it is certain that, as McGee has astutely observed, the satisfactory disposal of the rock-waste of the desert by prodigious wind exportation supplies the missing link to a rational explanation of all those long puzzling phenomena presented by arid regions throughout the world.

The potency of the wind as a geologic agent appears to be a function of humidity, and of plant growth which binds the soil. The erosional work performed is in inverse ratio to the rainfall. When the annual precipitation is reduced to 10 inches or less vegetation becomes scant and bunchy, true aridity begins to prevail, and the winds are given full opportunity to transport and deflate the dry loose soil materials. Desert conditions obtain, according to Murray, over not less than one-fifth of the entire land surface of the globe. Over another one-fifth of the lands eolian action is more or less pronounced. Still another one-fifth is, or was within very recent geological times, covered by snow fields and, speaking physiographically, is to be regarded as truly desert as the Sahara. So that one-half of the land surface of our earth is subject to a greater or less extent to degradation by winds. To some indeterminate extent wind work is also prevalent over the remaining half of the lands. That it is not a more widely recognized circumstance is due mainly to the fact that it is the humid lands with which we are most familiar; and in pluvial countries it is customary, albeit erroneously so, to regard the rains as the sole graving tool in land sculpturing.

In order to quantitatively measure the grander work of the wind as a geologic process, to compare its relative efficiency with that of other erosional agencies, and to view it when it is most energetically active, we must turn from our moist climate homes to regions of excessive dryness. Yet all arid lands and deserts do not display the differential effects of eolic erosion equally well. The substructure of a dry region is a prime factor in the relief expression. In a tract like the dry South African plateau where the rocks are homogeneous and unfolded the contrasted relief effects of the wind are not so very marked. On the other hand in a region of close patterned orogeny, such as the Great Basin of the western United States, the plains of the Southwest, and the Mexican tableland, the larger effects of the wind in re-forming the facial expression of the earth are most striking and wind work is seen at its best.

The relative efficiency of wind as a geologic agency of erosion is most readily measured by comparing its transportative powers. These are most often seen in the "dust storms" which are the most familiar and frequent of desert phenomena. But their geological effects are seldom considered because of the fact that they cause such utter discomfort to the traveler that he can think of little else than of devising means of mitigating the evil effects. Almost every brisk breeze in the desert stirs up a dust cloud. This may soon become so dense as almost to shut out the light of the sun. The books on desert travels are full of these accounts and the experiences have been vividly depicted ever since the dawn of history.

In the bottom of the air-stream flow along the coarse sands and fine gravels, almost solidly it seems, for a height of a foot or two from the ground. Above this basal stratum are the fine sands which usually reach to the height of a man. Higher is the dark dense dust cloud reaching up into the thin atmosphere for a distance of a mile or more. Viewed from the tops of mountains that have greater elevation the dense dust cloud lies like a thundercloud all around as sharply distinguished from the clear upper air as is a sheet of water. Unlike the lazy mist cloud all is rapid motion. The dust-ladened stream is rushing along as some vast mountain torrent.

The "dust storm" or "sand storm" is in reality as much a transportative agent as any river. Matched with a large river it is a titan among flowing, sediment-ladened currents. Its width is 200 to 300 miles instead of only one as in the case of the largest watercourses. It sweeps along at a pace of 40 miles an hour instead of barely three or four miles. It carries along a hundred thousand times more sedimentative materials, the great bulk of which is soon borne entirely out of the arid country into the semiarid and humid lands far beyond. The tremendous volume of this deflated rock waste is amply attested by the enormous loess formations, the broad expanses of black soils of the steppes and prairies, and the extensive beds of plains marls which are displayed in so many parts of the world, especially on the lee sides of deserts. Epeirotic deposits [1] of this origin are only beginning to receive the attention that they merit.

Owing to the fact that the wind sweeps up its chips as fast as it cuts them the magnitude of eolic erosion is at first difficult to measure with any great degree of accuracy. Except under specially favorable conditions definite figures can not always be given. Only when a desert chances to have somewhere on its boundaries remnants of old peneplains highly uplifted, may the extent of regional depletion be closely estimated. As do moist lands under the influences of stream activities, so arid regions soon develop strong contrasts of surface relief under wind action. The belts of weak rocks are first profoundly worn down, leaving the hard rockmasses protruding as mountains. In a region of uniform flat-lying strata the relief contrasts are not always conspicuous. When, however, there are rock-beds of great thickness, alternating hard and soft members, with close patterned mountain structures as in the arid lands of the western United States, differential relief effects attain maximum extremes. In this tract it is that the extreme youthfulness of the lofty desert mountains is at once impressed with amazing vividness upon the mind of the observer fresh from his pluvial homeland.

When once plainly discriminated, wind-graved relief expression is seldom mistaken for any other kind. Its individuality is very strong. Wind-beveled surfaces are smoother than water-formed plains possibly can be. The rock-floors which characterize so many desert plains are phenomena as novel as they are unexpected. Desert ranges rising abruptly out of the plains about impart characteristic form to the enisled landscape. The girdled mountain attests the vigor of natural sand-blast action, and its maximum effectiveness at the plain line. Plateau plains of the desert manifestly represent former levels of the general plains surface. The notable absence of foothills around the mountain ranges appears to be an idiosyncrasy of arid lands. The planation process takes place uphill as well as down; antigravitational gradation is unknown where streams erode. The high gradients of the intermont plains and the strong pitch of the valley axes which are displayed on every hand are not possible in regions where water action is directly the reverse of plains-forming. Of minor features attributable to wind abrasion in the lands of little rain, there are a multitude that have been ascribed to normal water corrasion but that are now known never to have been touched by stream. Upon all these the wind marks, when once pointed out are unmistakable.

It so happens that the great arid tract of western America has near its borders abundant traces of a former baselevel plain [peneplain] now raised more than 2 miles above sealevel. The attainment of its present position is regarded as having taken place in late Tertiary times. It no doubt once extended over all this desert region, at a level somewhat above the tops of most of the present mountains. Since desert conditions began to set in about the same time there is every reason to believe that the magnitude of the erosion is represented by the difference between this old peneplain level and the present plains level—an interval of 5,000 or 6,000 feet—or something over 1 mile of thickness over an area equal to almost one-quarter of the entire United States. There are many considerations supporting the assumption that this area before uplift was a vast plain and not a mountainous district when arid climate was inaugurated. The inappreciable aid of stream corrasion in this prodigious regional depletion is supported by the very fact of the prevalence of aridity. This region is one of the best extant demonstrating beyond peradventure the almost boundless potency of the wind as an epicene power in re-forming the face of the earth.

Thus under favorable climatic conditions of aridity such as prevail to-day over nearly one-half of the entire land surface of our globe wind-scour is the chief agency of provincial leveling and lowering far more rapid and efficacious than any general erosion work by rain or ocean.

[1] Deposits originating within and stopping within the boundaries of the dry lands.—C. A., Jr.

REDUCTION OF AIR TEMPERATURES AT SWEDISH STATIONS TO A TRUE MEAN.[1]

By NILS EKHOLM.

How far the material presented in this paper applies to American conditions is questionable. The experience of the Signal Service indicated that it was impracticable to require more than maximum and minimum temperature readings from its cooperative observers if satisfactory records were to be obtained in large numbers. In practice it has appeared that the mean temperatures from ½(max.+min.) form satisfactory planes of reference for comparison between different places and between different times at the same place, although the values thus obtained are almost always considerably higher than the means of the hourly observations. Charts and tables showing the corrections to be applied to means from different combinations of observation hours that have been used in the United States were published by Prof. F. H. Bigelow in United States Weather Bureau Bulletin S (Washington, 1909).

The accompanying abstract of Ekholm's paper is here presented in order to show the kind of study carried on in other countries; and also to emphasize the known fact that the mean temperatures universally employed in this country are convenient reference points rather than strictly true means.

The formulæ quoted are, for convenience, numbered consecutively in parentheses ( ); the designations used in Ekholm's original paper appear in brackets [ ].—*W. G. Reed.*

To obtain the true mean air temperature during any space of time hourly readings or better continuous autographic records are necessary. In the absence of

[1] Beräkning av luftens månadsmedeltemperatur vid de svenska meteorologiska stationerna. (Calcul de la température moyenne de l'air aux stations météorologiques suédoises.) Bihang till meteorologiska iakttagelser i Sverige, bd. 56, 1914. (Appendice aux observations météorologiques suédoises, vol. 56, 1914. [Swedish and French.] Stockholm, 1916. 111 p. f° *Abstracted* for the REVIEW.

such records the only satisfactory method consists in applying a correction to the mean deduced from the observations, of which the following are examples:

$$t_m = \tfrac{1}{3}(t_7 + t_{13} + t_{21}) + c_3 \quad (1)\ [3]$$
$$t_m = \tfrac{1}{2}(t_8 + t_{20}) + c_7 \quad (2)\ [7]$$

where t_m is the true mean, t_7, t_8, etc., are the means at the hours indicated by the inferior figures (8 = 8 a. m., 20 = 8 p. m., etc.) and c_3 and c_7 are constants calculated separately for each month of the year for each station where hourly observations are available. There are, of course, many similar formulæ which have been studied in detail for various stations in Europe. To comply with the Swedish observation hours, 8^h, 14^h, and 21^h (8^a, 2^p, and 9^p) the following formula has been devised:

$$t_m = \tfrac{1}{3}(t_8 + t_{14} + t_{21}) + c_{10} \quad (3)\ [10]$$

Prof. Erik Edlund devised the following formula in 1859 for reductions at Swedish stations

$$t_m = \tfrac{1}{7}(t_8 + t_{14} + 5t_{21}) + c_{11} \quad (4)\ [11]$$

because his studies led him to believe that in this case $c = 0$. The Swedish observations up to 1913 were reduced by this formula and published by the Royal Academy of Sciences.

Although the fact has not been emphasized it is obvious that considerable errors may be introduced unless the observation hours refer to local time at the station. The local time of each station was employed from 1859 to 1878; from 1879 to 1899, Swedish Standard Time (mean civil time of the Stockholm Observatory) was used, and since 1900 Central European Time (one hour earlier than G.M.T.). The result is that the observations vary from about 15 minutes before to about 36 minutes after the corresponding local time. These changes of hour probably introduce considerable errors, at least in the warmer months, in the means calculated by Edlund's formula, which gives to the observation at 21^h a weight of five times that of each of the others. To obviate this difference various attempts have been made to determine coefficients for the means for each observation hour, so that c shall still remain equal to 0.

There are now available for a study of this relation hourly values from the following five observatories:

Station.	Latitude N.	Longitude E.	Altitude.	Time of observation.	Years of record.
	° ′	° ′	*meters*		
Vassijaure	68 25	18 11.0	506	$12^m\ 44^s$ after local time	*1905–1915
Abisko	68 21	18 47.0	388.5	$15^m\ 30^s$ after local time	1913–1915
Upsala	59 51	17 35.5	24.0	$10^m\ 30^s$ after local time	1896–1913
Kristiania	59 55	10 43.0	22.5	Local time	1896–1913
Hamburg	53 33	9 58.5	26.0	Local time	1899–1909

* With several breaks.

A detailed comparison of the means of the 24 hourly observations with those deduced by the various formulæ hitherto suggested, shows that all are subject to errors too large to permit true values to be deduced by their use, especially for the summer months. The best of these formulæ is

$$t_m = pt_8 + qt_{14} + rt_{21} \quad (5)\ [12]$$

where p, q, and r are coefficients and

$$p + q + r = 1 \quad (6)\ [13]$$

Rubenson has stated this formula as follows:

$$t_m = pt_8 + qt_{14} + rt_{21} + st_n + xt_x \quad (7)\ [12\ \text{quater}]$$

where t_n is the mean of the daily minima, t_x is the mean of the daily maxima, and p, q, r, s, x, are constants, which must be calculated from the observations. In using formula (7) it is often possible to write $x = 0$, because it is frequently true that $t_x = t_{14}$. Rubenson's work [using centigrade temperatures] gives values for p varying from 0.34 to 0.37, depending on the month; for q from 0.07 to 0.27; and for r from 0.35 to 0.59.

The differences between local time and standard time make it necessary to write formula (5)

$$t_m = pt_7 + qt_{14} + rt_{21} + c_{Ma} \quad (8)\ [\text{Ma bis}]$$

where values for c_{Ma} for Swedish stations vary from -0.09 to $+0.17$ depending on the month and the longitude. For most of the months this formula appears satisfactory; it is of least value for May, June, July, and August. For July it is not possible to deduce a true mean without applying a constant. The formula then becomes

$$\left.\begin{aligned} t_m &= pt_8 + qt_{14} + rt_{21} + c \\ \text{when}\quad p + q + r &= 1, \end{aligned}\right\} \quad (9)\ [R]$$

c being equal to 0 for all months except July. The best results for May, June, July, and August are obtained when the following pair of formulæ are adopted:

$$\left.\begin{aligned} t_m &= pt_8 + qt_{14} + rt_{21} + st_n \\ p + q + r + s &= 1 \end{aligned}\right\} \quad (10)\ [S]$$

which is a special case of formula (7). Formula (9) was first used in a simplified form by placing $c = 0$ and $p = r$. This resulted in good values for t_m for Upsala, but was not satisfactory for the other four observatories. From a study of the data of the five observatories by the method of least squares, it appeared that the best means are obtained by the use of the equation

$$t_m = 0.01(pt_8 + qt_{14} + rt_{21} + st_n) \quad (11)$$

where values for p vary from 22 to 39 depending on the month and the longitude; those for q, from 15 to 27; those for r, from 36 to 55; and those for s being 0 for all months, except from May to August, inclusive, when s varies from 0 to 11. For stations not observing the minimum temperature the values for May to August, inclusive, may be more or less adequately calculated from the equation

$$t_m = 0.01(pt_8 + qt_{14} + rt_{21} - c) \quad (12)$$

where values for p vary from 19 to 35; those for q, from 6 to 23; those for r from 51 to 57; the values of c being 0 for all months, except July when they vary from 23 to 39.

The best means are those calculated from these values. Most of the corrections required to bring the calculated means to the true means lie between the limits -0.04°C. and $+0.04$°C., which are practically negligible. The extreme limits of the corrections are -0.2°C. and $+0.2$°C. in the great majority of cases, and it is only in isolated instances that greater corrections are necessary. These are -0.4°C. (May and August), -0.3°C. (May, June, July, and August), and $+0.3$°C. (September). It is striking that these large sporadic corrections were much more often negative than positive, that is the calculated mean is in the extreme cases of difference much more often too high than too low. This seems to result from the fact that the mean for the 21^h observation is at times abnormally high in the warmer months. The greatest negative corrections were -0.42°C., -0.40°C., and -0.36°C. for May, 1897, and -0.39°C. for August, 1880, all in the Upsala series. The greatest positive correction was $+0.34$°C. for September, 1875, in the same series.

FORMATION OF WINTER STRATUS; DEPTH OF NORTHEAST WIND.

ALEXANDRIA BAY, N. Y.,
February 20, 1917.

DEAR SIR:

(1) As you will have observed from the weather maps, the long-continued cold weather that has prevailed during the past several weeks, accompanied by snowstorms of short duration but great frequency, causing more and deeper snow than "the oldest inhabitants" can boast of, it is needless for me to write at any length on this subject; but I thought it might be of interest to say that during this wintry period the absence of any well-defined cloud form has been remarkable. I have not observed any true cirrus, cirro-cumulus, or alto-cumulus, and rarely any strato-cumulus. All cloudy periods came on by a gradual thickening of the blue sky into a milky sheet, causing the sun to shine with a pale light, and even when the snow fell in seemingly large amounts the sun could usually be seen shining feebly. On a few occasions I could trace out a cirrus streamer, but it was ill-defined and soon lost its form, taking on a uniform milky haze.

(2) I might add that the Northern Lights, which were so brilliant in the Fall, completely failed us, until a few evenings ago a faint arch appeared.

(3) The cold northeasterly winds which we get in front of advancing LOWS must be very [thin] sheets of air, i. e., extend to but a short distance above the earth, for on several occasions we have had rain with the temperature but a few degrees above 0°F.

Yours, very truly,

DOUGLAS MANNING.

Dr. W. R. Blair, in charge of aerological investigations, makes the following comments:

The cloud formation described in paragraph (1) above is not an unusual winter type. The thin layer of stratus begins forming at a considerable altitude and apparently thickens by continuing to form at lower and lower levels. Measurements on the height of the base of this layer, by means of kites, indicate that the interval from the time when the first cloud formation is visible (usually in a white sky) until the layer is 2 or 3 kilometers thick, amounts to but a few hours.

Our upper-air observations indicate that the cold northeasterly wind mentioned in paragraph (3) does not often exceed 1 kilometer in depth.

ATMOSPHERIC CIRCULATION AND THE WEATHER IN ARGENTINA.[1]

By H. HELM CLAYTON, Chief, Department of Weather Forecasts.

[Dated: Argentine Meteorological Office, Buenos Aires.]

Argentina lies between the tropical high-pressure belt and the low-pressure belt of the Antarctic Circle. As a result of this pressure distribution and the rotation of the earth the general air movement is from the northwest. The principal seasonal change in pressure distribution is in the interior between the northern boundary and latitude 35° S., where a relatively low pressure in Summer (December to January) is replaced by a relatively high pressure in Winter (June to August), probably as a result of the heating and cooling of the continent. The seasonal change in pressure brings about a marked increase in the frequency of rain-bearing NE. to SE. winds in Summer and an increase in the drier offshore winds in Winter.

Besides the annual changes there are the well-known diurnal changes in pressure and winds. The observations show the maximum pressure central over the arid regions of western Argentina at night, and the minimum over the same region during the day. The winds at Córdoba and at Buenos Aires show clearly the influence of the daily pressure wave.

In addition to the more or less permanent arrangement of pressure and wind belts around the earth, and the annual and daily changes, there are the moving cyclones and anticyclones, of which 10 types, 4 of high pressure and 6 of low pressure, have been recognized in Argentina. The anticyclones usually appear in the southwest and move northeastward. They appear to be the result of masses of cold air which break off from the polar region and progress northward toward the equator, but at the same time they are carried eastward by the general drift of the atmosphere. When the movement of the centers is unusual, they are frequently found associated with changes in the prevailing atmospheric drift. The anticyclones show a tendency to linger about latitudes 30° to 35° S.

The movements of the cyclones are much more erratic than those of the anticyclones. In Winter and Spring they are apt to linger in the vicinity of the Paraná, which is a region of moisture and comparative warmth in Winter. In Summer the cyclones linger over the hot arid plains between Mendoza and Santiago. The movements of the cyclones seem to be controlled chiefly by two factors: (1) The upper drift, which may be determined roughly by the general trend of the sealevel isotherms, because temperature is the main factor in determining upper air pressures; and (2) the sealevel pressure over large areas, which determines the general drift of the lower air. Cyclones are frequently observed moving around large anticyclones in the same direction as the circulating wind.

The motions of the atmosphere are not all explained by daily and annual changes and the passage of cyclones. There are changes occupying days, weeks, months, or years the nature of which is not entirely clear. These changes may be analyzed into waves of different lengths of which the shorter progress more rapidly. Not only do the different waves progress with different speeds, but also in different directions; also they vary in amplitude as they progress, and waves of the same period change their direction of motion from day to day. However, it has been possible to analyze them roughly, to select predominating conditions, and to base useful forecasts on the results.

[1] *Abstract*, by W. G. Reed, of the chapter under this title in: Servicio meteorológica argentina, Historia y organaración, con un resumen de los resultados. Buenos Aires, 1914. pp. 146-153, and charts.

THE ARGENTINE METEOROLOGICAL SERVICE.[1]

[ABSTRACT by WM. G. REED.]

The establishment of the Argentine meteorological service—which was due to the initiative of Dr. B. A. Gould, founder of the astronomical observatory at Córdoba—was effected by a law approved toward the end of 1872. The central office was installed in the observatory at Córdoba, but the two institutions were entirely independent, except for having a director in common. During Gould's administration 52 stations were established, at 23 of which observations were made for more than three years; but so many of the observers lost interest that, at the time of his retirement in 1884, there were only 17 active stations, although the service was established on a permanent basis. Four volumes of observations and discussions had been published; isothermal maps had been made, the essentials of which have scarcely been altered by more recent data; and rainfall data for Argentina and surrounding regions had been collected.

[1] República Argentina, Ministerio de Agricultura, Servicio meteorológica argentina Historia y organización, con un resumen de los resultados. Preparado baja la dirección de Gualterio G. Davis, Jefe del servicio. 181p. 69pl. Buenos Aires, 1914 [in Spanish and English].

In 1885, when Walter G. Davis became director, the central office was moved from the astronomical observatory to a new building in Córdoba, and the number of instruments was increased so that all the usual meteorological studies could be made. During the following years the program of the founder was continued, the network of stations contnually increased, installations improved, and stations frequently inspected.

The observations were reduced, discussed, and published as funds permitted. At the end of 1901 the observations from 47 stations, many of which included regions distant from the centers of population, had been published. At this time the Central Office was moved to Buenos Aires as the extension of telegraph lines to outlying regions had made it possible to obtain telegraphic reports of simultaneous observations from the Bolivian frontier to Santa Cruz and from the Andes to the Atlantic. At the end of 1901 the service included 11 first-class stations with automatic registers; 68 second-class stations at which observations of pressure, temperature, wind direction and force, cloudiness, and precipitation were made at 7 a. m., 2 p. m., and 9 p. m.; 9 third-class stations which differed from the second class only in not having barometers; and 240 rainfall stations. With few exceptions these stations were accessible by telegraph.

The first daily meteorological bulletin appeared on January 1, 1902, and *the first daily weather map* on February 21 of the same year. Up to September, 1902, the data were based on the 2 p. m. observation; but owing to delays in telegraphing, it was not possible to publish the map before midnight, and it did not reach the public until the following morning. Beginning with September, 1902, the 7 a. m. observations were used for the map until December 31, 1903. On January 1, 1904, the observation hours were changed to 8 a. m., 2 p. m., and 8 p. m.; the morning observation was used for the weather map. From July, 1904, the 8 p. m observation of the preceding day was included in the morning telegram. The map was published in the printing establishment of the Meteorological Office, which also handled all the publications of the Ministry of Agriculture.

In September, 1904, *the forecasting service* began; forecasts were made for the 36-hour period ending at 8 p. m. of the following day. Forecast display flags were used at the principal Atlantic ports and the forecasts were delivered to the National Telegraph lines for transmission to the telegraph offices throughout the country. When the forecast work was inaugurated the service had, at places accessible by telegraph, 140 stations where all elements were observed and 420 rainfall stations in Argentina, as well as the observations by exchange of 5 Brazilian, 1 Uruguayan, and 1 Chilean station. In November, 1904, these data were increased by a nightly synopsis which gave the weather conditions since the morning observation. This synopsis was sent by a number of stations sufficient to give a general idea of the weather prevailing during the day; it was given to the morning papers for publication.

In the beginning of 1904 the Meteorological Office took charge of *the meteorological and magnetic station established on Laurie Island* in the South Orkneys by the Scottish Antarctic Expedition during the preceding summer (1902–3). This station has been continued, the observers being relieved each summer (December or January). Hourly direct meteorological readings of all the instruments are made, and automatic registers have been running since the station was established. Two complete sets of absolute magnetic observations have been made each week and the photographic variometers are constantly in use. The only interruptions are those due to the need of repairs which could not be made with the equipment at hand.

With the station on Laurie Island, $\phi = 60° 43'$ S, the Argentine Meteorological Service has an extension in latitude of nearly 40 degrees, in which there are 42 first-class stations, 152 second-class stations, 12 third-class stations, and 1,930 rainfall stations. The 8 a. m. and 8 p. m. observations from 190 of these stations of the first, second, and third classes in Argentina and Paraguay are used in the construction of the weather map, besides the rainfall from about 1,350 stations, and, in exchange for Argentina data, the general observations made at 8 a. m. from 6 stations in Uruguay, 10 in Brazil, and 26 in Chile.

The Hydrometric Section was established in July, 1902, to study the stream flow and water resources of Argentina, and to provide for flood warnings. Daily gage readings have been made of the more important rivers and the hydrography of many possible dam sites has been more or less completely studied. Reports have been made on the topography of certain drainage basins and irrigation projects. The possibilities of utilizing river water, especially for irrigation, and those of hydroelectric power development have been partially examined. In 1912 the section began the measurement of ground water levels. In June, 1913, the publication of a synopsis and forecast of river stages was commenced in the daily weather map. Discharge curves have been calculated for many of the rivers.

The Magnetic Section was established in 1904 at Pilar in the Province of Córdoba. Magnetic observations had been made from time to time in Argentina since early in the 19th century. Systematic work began at Pilar when the Meteorological Office took over the station in the South Orkneys. Field operations in various parts of the country were carried out in 1904, and again in 1908 and 1912–1913, when the same stations were occupied to determine the rate of secular change.

REPORT OF THE METEOROLOGICAL STATION AT BERKELEY, CAL., FOR THE YEAR ENDING JUNE 30, 1915.[1]

By WILLIAM GARDNER REED.

[*Author's abstract*, submitted Mar. 12, 1917.]

The work of the Meteorological Station maintained by the University of California was carried on by the Department of Geography during the year ending June 30, 1915. A complete statement of the history of the station and of the instruments and exposures was published in the reports for the years ending June 30, 1913,[2] and June 30, 1914.[3]

Pressure.—Pressure was measured twice daily, at 8^h and 20^h, mean civil time of the 120th meridian west from Greenwich (16^h and 4^h Greenwich mean civil time, or 8 a. m. and 8 p. m., Pacific Standard Time, the time in local use). The barometer in use is a Fortin cistern mercurial instrument of the United States Weather Bureau pattern. Although pressure relations are doubtless of great importance as showing the character of the seasons in California, unfortunately no correlations have been made between monthly pressures and other meteorological conditions at

[1] Univ. Cal., Publ. geogr., Berkeley, Feb. 28, 1917, **1**: 441–504.
[2] *Abstract in* MONTHLY WEATHER REVIEW, Mar. 1914, **42**: 164–166.
[3] *Abstract in* MONTHLY WEATHER REVIEW, Apr. 1916, **44**: 202–204.

Berkeley. February, generally a month of considerable cyclonic activity, showed even greater pressure variations than usual. The total range in February, 1915, was 39.6 mb., 30 mm., or 1.17 inches, which is only 0.4 mb. less than the annual range. The range in a single cyclone in February was 39.4 mb. The lowest pressure in the year ending June 30, 1915, was 990.8 mb., 743 mm., or 29.26 inches, at 13h (1 p. m.), on January 29, during a cyclone which produced a depression of the barograph trace more marked than any previously recorded at Berkeley since the beginning of continuous pressure records in July, 1912. This pressure is one of the notable low pressures at Berkeley and is the lowest record for January.

The relation between temperature and pressure does not appear close, as judged by the data for 1914–15. The departures from the mean monthly and mean monthly minimum temperatures show very little similarity to the pressure departures. This information is contained in Table 3.

TABLE 3.—*Comparison of departures from 28-year averages, Berkeley, Cal., 1914–15.*

Month.	Mean monthly pressure.	Mean monthly temperature.	Mean minimum temperature.	Total monthly precipitation.
1914.	*mb.*	*° A.*	*° A.*	*mm.*
July	+3.1	±0	−1	−0.5
August	+2.4	±0	±0	−1.0
September	+1.7	±0	−2	−14.2
October	−0.1	+1	±0	−15.1
November	+0.8	+1	±0	−57.3
December	−2.0	−1	−1	+58.2
1915.				
January	−1.7	±0	±0	+23.9
February	−3.0	+1	+1	+101.9
March	−1.2	+3	+1	−69.8
April	−1.2	+1	−1	−14.8
May	−0.2	±0	−1	+101.4
June	+0.4	−1	−1	−5.3
Year 1914–15	+0.6	±0	−1	+107.4

Temperature.—While it has not been practicable to determine the pressure conditions at times of very high or very low temperature at Berkeley, it may be noted that neither the minimum temperature and the maximum pressure, nor the maximum temperature and the minimum pressure, occurred on the same day in 1914–15. In general, high temperatures occur with "north wind" conditions; these high temperatures result from strong insolation due to clear skies and low humidities, together with dynamic warming of rapidly moving and descending air. This condition is the result of high pressure over the Basin Region rather than of any particular pressure relations at Berkeley. Low pressures occurred at Berkeley during the passage of cyclones, and at such times the sky was overcast and rain falling, so that opportunities for strong insolation were wanting, and hence low pressures were not accompanied by high temperatures. The highest temperatures are apt to occur in the late summer, when the coast fog has ceased to be a factor, or in the early summer before the fog conditions have set in. The lowest temperatures have occurred during winter anticyclones. The amount of the daily range depends to a large extent upon the sunshine and cloudiness; months with considerable cyclonic or "velo" cloud have small daily ranges. The greatest daily range of the year, 23°A. (41°F.), occurred on September 10, which was the day with the highest mean temperature, and also the day with the highest maximum. The smallest daily range was 2°A. (3°F.), on May 10, during a period of cyclonic rainfall, although the pressure relations at this time are somewhat obscure. The annual mean range; that is, the temperature difference between the warmest and the coldest month, for 1914–15, was slightly less than the mean daily range. The average of the 28 years is the same as the mean daily range for the 28 years. As has been previously pointed out, this correspondence is due to the location of Berkeley on the "meteorological tropic."

TABLE 4.—*Extreme temperatures at Berkeley, Cal., July, 1887–June, 1915.*

Month.	Maximum.			Minimum.		
	°A.	*°F.*	*Date.*	*°A.*	*°F.*	*Date.*
July	309	97	7, 1905	288	42	29, 1899
August	307	93	22, 1891	281	46	31, 1905
September	314	106	16, 1914	281	46	28, 1905
October	308	95	1, 1914	277	39	18, 1905
November	301	82	16, 1895	274	33	28, 1905
December	294	70	24, 1901	272	31	24, 1905
January	298	77	26, 1899	269	25	14, 1888
February	299	80	18, 1899	271	29	12, 1905
March	304	87	17, 18, 1914	274	34	30, 1905
April	303	87	24, 1913	275	36	19, 1896
May	307	92	26, 1896	277	40	1, 1899
June	311	101	6, 1903	279	42	2, 1903
Year	314	106	Sept. 16, 1914	269	25	Jan. 14, 1888

Humidity.—In Table 5 an attempt has been made to show the average of the greatest strain on organisms each day. This strain is, perhaps, best indicated by the maximum saturation deficit, which is the saturation deficit [4] at the time of maximum temperature. The values given in the table are to be regarded as approximations, as they were obtained from the mean maximum temperatures and from vapor pressures computed from psychrometer readings at 20hrs (8 p. m.). This is incorrect in theory, as the saturation pressure increases much more rapidly than the temperature, but a study of the actual saturation deficits at selected times showed that no appreciable error was introduced.

TABLE 5.—*Mean daily maximum saturation deficit at Berkeley, Cal.*

[Difference between saturation and actual vapor pressures at time of daily maximum temperature.]

Month.	1914–1915		1892–1915	
1914.	*mb.*	*In.*	*mb.*	*In.*
July	7	0.28	8	0.30
August	7	0.28	7	0.26
September	10	0.38	8	0.30
October	11	0.41	7	0.28
November	11	0.41	5	0.20
December	4	0.15	4	0.14
1915.				
January	4	0.16	3	0.11
February	4	0.15	4	0.16
March	4	0.15	3	0.11
April	6	0.23	6	0.22
May	6	0.23	7	0.25
June	7	0.24	8	0.31
Year 1914–1915	7	0.26	6	0.22

NOTE.—These values were estimated from saturation pressures determined from the mean maximum temperatures by the use of the Marvin tables (U. S. Weather Bureau, psychrometric tables for obtaining the vapor pressure, relative humidity, and temperature of the dew point from readings of the wet- and dry-bulb thermometers, Washington, 1912) and the average 20 hours (8 p. m.) vapor pressures. A partial study showed that the errors of this method are small and have a tendency to cancel out. It is probable that the errors in the result shown in the table are less than those due to exposure conditions.

Cloudiness.—Cloudiness at Berkeley, specially in summer, is closely related to atmospheric moisture. The summer cloud at Berkeley is usually the low stratus or velo [5] cloud, locally in California known as "high fog";

[4] The *saturation deficit* may be defined as the difference between the vapor pressure at any time and the saturation pressure at the current temperature. It is a measure of the lack of saturation and hence of the tendency to evaporation.

[5] *Carpenter, F. A.* The Climate and weather of San Diego, Cal. San Diego, 1913. pp. 5–7.

the winter cloud is almost always of cyclonic origin, as is some of the summer cloud.

The partly cloudy days may be divided into two groups: Those on which the sky was from three-tenths to seven-tenths cloud-covered through the day, and those on which the sky was more or less overcast for a part of the day, usually morning and evening. The first group is associated with the margin of a cyclone and is, therefore, a winter rather than a summer phenomenon, although not unknown in the summer. The second type is associated with fog or velo cloud conditions in the morning and evening with clear sky through the day; this type is more common in summer, although it occurs with "tule" fog in winter, and also sometimes with the approach or departure of a cyclone.

Cloudy days occur in winter with cyclones and in summer when the velo cloud persists through the day. Under the conditions of observation at Berkeley, the distinction between clear and partly cloudy days is usually well marked, and the records of different observers show practically the same number of clear days; but the distinction between partly cloudy and cloudy days is not so sharp, different observers often estimating the same day as cloudy or partly cloudy, the difference being the result of the personal equation or the exact times when sky conditions are noted.

Fog.—At stations near the California coast the adequate treatment of fog is difficult, because of the broken character of the topography, with the resulting difference in altitude, which makes any record of fog according to the ruling of the International Meteorological Committee[6] applicable only to the spot where the observation was made. The difficulty is not so great in the case of the "tule" fogs of winter, which are very dense and fill the valleys, including the valley of San Francisco Bay, to the top of the fog layer; this is usually clearly marked at 100 to 150 meters (300 to 500) feet above sealevel. The summer fog is a much more complex phenomenon. It is partly formed over the Pacific Ocean, probably by mixture, and is carried to the land by the westerly winds of summer, often in detached masses. At times this fog comes in at the surface of the earth and at times it appears as a low stratus or fracto-stratus cloud—the velo cloud of Carpenter. A further difficulty results from the fact that the fog is not always formed over the ocean, but the slight cooling resulting from the deflection upward by the Berkeley Hills is frequently sufficient to produce fog. All gradations exist, from a dense surface fog enveloping the whole of the San Francisco Bay region to small patches of fracto-stratus cloud on the higher portions of the Berkeley Hills.

Frost.—Although the frost record is not complete, this phenomenon seems to occur annually at Berkeley; it is probable, however, that frosts properly classed as "killing" do not occur every winter. Light or heavy frosts occur more or less frequently between early November and early April. In 1914–15 frost was recorded on 14 mornings, of which 11 were in December and 3 were in January. November and March were too warm for frost, and February was a month of cloud and rain, which prevented nocturnal cooling. Frost characteristically occurs at Berkeley on anticyclonic nights when the terrestrial radiation is strong, usually after considerable transfer of air from the dry continental interior.

At Berkeley in 1914–15 but one thunderstorm was recorded, although lightning was reported once in addition (January 11).[7] The thunderstorm occurred about noon on February 16, and was accompanied by hail. An unusual feature of this thunderstorm was its time of occurrence, the relatively rare thunderstorms of west coast regions almost always occurring at night during periods of cyclonic clouds. February 16, 1915, appears from the barograph trace to be about the middle of a cyclonic period, and showers occurred during the day and the preceding night.

Precipitation.—The number of days with measurable precipitation (0.2 mm., 0.01 inch, or more) was 87 for the year, which is about 30 per cent more than the 28-year average. The greatest number of rainy days in any one month was 19 in February, making a new record for this month. This number has been exceeded in only three months since the beginning of the record.

Figure 1 is an attempt to show the duration of periods without measurable precipitation and of continuous periods during which the daily rainfall was 0.2 mm. or more. All records of rainy days are referred to the rainfall day of the station, which is the 24 hours ending at 20^h (8 p. m.) mean civil time of the 120th meridian. The date is the civil date on which the last 20 hours of

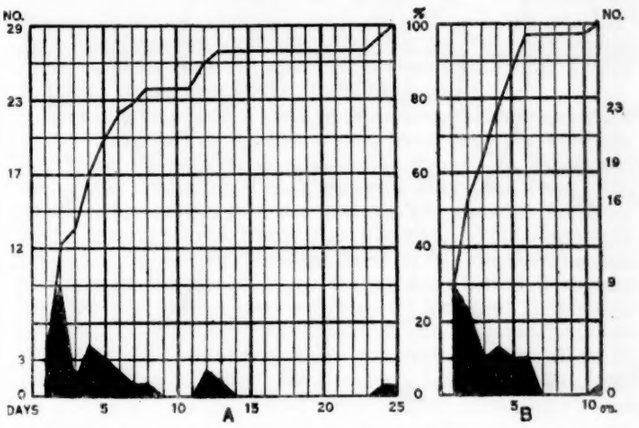


Fig. 1.—A, consecutive days without precipitation; B, consecutive days with precipitation; Berkeley, Cal., September 7, 1914, to May 24, 1915.

the rainfall day falls; that is, the rainfall day ends four hours before the civil day. Diagram A of figure 1 shows by its shaded area the percentage of occurrence of rainless periods of different duration between the first rain in Fall, September 7, and the last rain in Spring, May 25. Of a total of 29 such periods, 3 were of 1 day's duration, 9 were of 2 days' duration, and so forth. The line is a summation of the periods shown by the shaded areas; for example, 12 periods or 40 per cent of the total lasted for 2 days or less. There was no period without rain of more than 25 days' duration, except the long dry Summer at the beginning and end of the meteorological year; this is not shown by the diagram. The record has included only the fact of precipitation of 0.2 mm. (0.01 inch), or more on the rainfall day; if rain was falling long enough before and after 20^h (8 p. m.) for a measureable amount to be collected, both rainfall days were counted as days with precipitation. Figure B is similar to figure A, except that it shows periods of consecutive rainfall days on which measureable precipitation occurred. There were during the year 30 such periods. Of these 9, or 30 per cent, occurred within 1

[6] "Fog is to be recorded only when the observer is enveloped in it." Internationaler Meteorologischer Kodex, ed. 2, Berlin, 1911.

[7] "Only days on which both thunder and lightning are observed are to be counted as days with thunderstorms." Internationaler Meteorologischer Kodex, ed. 2, Berlin, 1911, p. 19.

rainfall day; 7, or 23 per cent, occurred on 2 rainfall days, and so forth. The longest period with daily rain was 11 days. The line is the summation of the periods shown by the shaded areas.

The total precipitation for the year 1914–15 was 786.1 mm. (30.95 inches), which is 107.4 mm. (4.20 inches); that is, 16 per cent more than the average annual amount based on the 28 years of the Berkeley record. The precipitation for each month is shown by Table 1, and the monthly averages appear in Table 2. The rainiest month was February, with 207.8 mm. (8.18 inches); this is nearly twice the February average. The

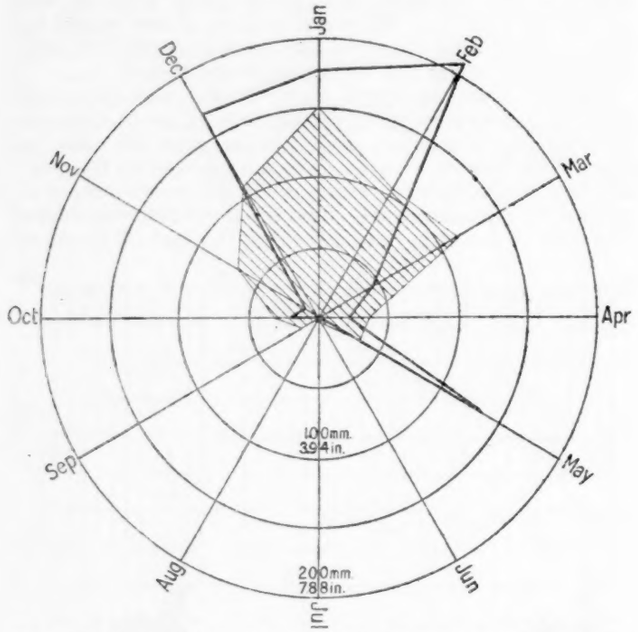


Fig. 2.—Monthly precipitation at Berkeley, Cal., 1914–15, and (shaded area) average monthly precipitation, 1887–1915.

May rainfall, 133.6 mm. (5.26 inches) is a new record for May; it is 46.5 mm. (1.83 inches) more than the amount for May, 1905, the May of heaviest precipitation previous to 1915. Table 6 shows the accumulated excess or deficiency in precipitation at the end of each month of 1914–15 as compared with the average of the 28 years. The accumulated amounts for the year were below the average until January, but after that month there was an excess. At the end of May the excess was 112.7 mm. (4.44 inches); but on account of the dry June the excess at the end of the meteorological year was only 107.4 mm. (4.20 inches).

TABLE 6.—*Monthly and seasonal precipitation at Berkeley, Cal., July 1, 1914–June 30, 1915; with averages for 28 years and departures from the averages.*

Month.	Monthly.		Seasonal to end of month.		Average seasonal.		Departure, 1914–15.	
1914.	*mm.*	*In.*	*mm.*	*In.*	*mm.*	*In.*	*mm.*	*In.*
July	T.	T.	T.	T.	0.5	0.02	−0.5	−0.02
August	0.0	0.00	T.	T.	1.5	0.06	−1.5	−0.06
September	0.5	0.02	0.5	0.02	16.2	0.64	−15.7	−0.62
October	21.3	0.84	21.8	0.86	52.6	2.07	−30.8	−1.21
November	10.9	0.43	32.7	1.29	120.8	4.75	−88.1	−3.46
December	167.1	6.58	199.8	7.87	229.7	9.04	−29.9	−1.17
1915.								
January	176.7	6.96	376.6	14.83	382.6	15.05	−6.0	−0.23
February	207.8	8.18	584.4	23.01	488.5	19.22	+95.7	+3.79
March	46.5	1.83	630.9	24.84	604.8	23.81	+26.1	+1.03
April	21.6	0.85	652.5	25.69	641.2	25.24	+11.3	+0.45
May	133.6	5.26	786.1	30.95	673.4	26.51	+112.7	+4.44
June	0.0	0.0	786.1	30.95	678.7	26.72	+107.4	+4.23
Season 1914–15	**786.1**	**30.95**	**786.1**	**30.95**	**678.7**	**26.72**	**+107.4**	**+4.20**

TABLE 7.—*Summary of precipitation by rainfall days, Berkeley, Cal., 1914–15.*

[The rainfall day is the 24 hours ending at 20h (8 p. m.) mean civil time of the 120th meridian west from Greenwich (4h Greenwich mean civil time).]

Month.	Total precipitation.	Days with precipitation.			
		≥0.2 mm.		≥1.0 mm.	
		No.	Average precipitation.	No.	Average precipitation.
1914.	*mm.*		*mm.*		*mm.*
July	T.	0	.....	0	....
August	0.0	0	.....	0	....
September	0.5	1	0.5	0	....
October	21.3	4	5.3	2	10.4
November	10.9	4	2.7	4	2.7
December	167.1	14	11.9	14	11.9
1915.					
January	176.7	17	10.4	16	11.0
February	207.8	19	10.9	16	12.9
March	46.5	9	5.2	8	5.8
April	21.6	5	4.3	5	4.3
May	136.6	14	9.6	10	13.1
June	.....	0	.....	0	....
Year	**786.1**	**87**	**9.0**	**75**	**10.4**

Forty rainy cyclones were recognized, with a total of 785.6 mm. (30.93 inches) of rain. This includes all the rain of the year, except a small amount from a fog shower on September 7. The average precipitation per cyclone with rain was 19.6 mm. (0.77 inch). This is somewhat more than the average for 1913–14; the difference seems to be real, although in such a matter the success with which cyclones have been separated is an important factor.

The two cyclones with the greatest precipitation each had 66 mm. (2.60 inches) of rain; the duration of one was 4 days, and that of the other was 5 days. At least two true cyclones resulted in only a trace of rain at Berkeley.

Winds.—Wind direction was observed regularly at 8h and 20h (8 a. m. and 8 p. m.), 120th meridian time. As it has not yet been possible to install a proper wind vane, the observations are subject to considerable error. The observation hours are times at which the wind direction on the campus is most apt to be influenced by feeble drafts from Strawberry Canyon. The wind directions at the observation hours are the result of one or more of the following tendencies: (1) the prevailing surface drift of the air from a southwesterly or westerly direction; (2) a flow of air from the hills due to local cooling, specially important at the time of the evening observation, 20h (8 p. m.), 120th meridian time; (3) cyclonic winds, generally from the south or southeast, the result of a cyclone central north of Berkeley; and (4) anticyclonic winds resulting from the development of comparatively high pressures more or less connected with the continental hyperbar, these winds being generally from the north or northeast.

All directions except those of the three octants between southeast and west are of comparatively minor importance, although north and northeast winds have a very marked influence on the character of the days on which they occur; these days are hot and dry on account of the dynamic warming of the rapidly moving and descending air. Their number is, however, very small. Calm was recorded at 94 observation hours, which appears to be somewhat less than the average; but because of the generally low wind velocities the records made by different observers can not be regarded as homogeneous.

The seasonal and monthly distribution of winds from the different directions is shown by Table 1 and also in part by figure 3. This figure is the result of an attempt to distinguish summer and winter conditions by the daily prevailing winds. The solid line of figure 3 shows by months the percentages of days with prevailing winds from the southwest and west. Southwest and west winds

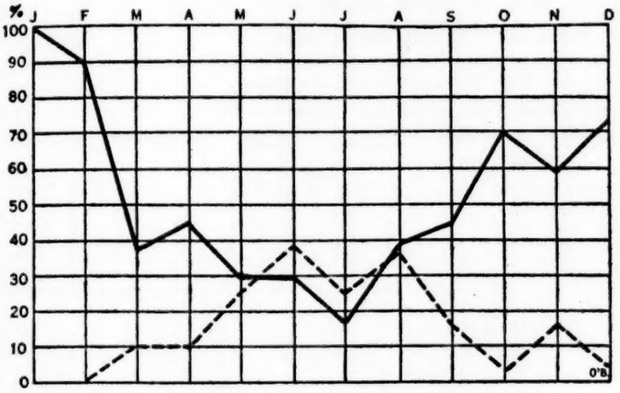


Fig. 3.—Summer and winter winds at Berkeley, Cal., 1914-15.
— Percentage of days with the prevailing wind direction southwest or west.
--- Percentage of days with the prevailing wind direction southeast or south.

are those associated with summer conditions. The broken line shows in the same manner the percentage of days with prevailing winds from the southeast and south, the characteristic cyclonic wind directions at Berkeley. This diagram shows the winter or summer characteristics of each month as indicated by the wind directions. As is to be expected, the months with high percentages of summer prevailing winds are those with low percentages of winter prevailing winds.

SUMMARY.

The mean sea-level equivalent of the air pressure at Berkeley for the year ending June 30, 1915, was 1016 mb., about the average pressure for the 28 years of record. The departures of the monthly means were small and irregular. The highest pressure, 1031 mb., occurred on February 4, and the lowest, 991 mb., on January 29. Neither is a new record for Berkeley, although the minimum for the year was a notably low pressure.

The mean temperature for the year was 287 degrees A (57 degrees F.), which is practically the average for Berkeley; the mean annual range was 9 degrees A (15 degrees F.), and the annual extreme range, 33 degrees A (58 degrees F.). The highest temperature was 307 degrees A (94 degrees F.), on September 10; the lowest was 274 degrees A (36 degrees F.), on December 8. The mean monthly range was 20 degrees A (36 degrees F.); the mean daily range was 10 degrees A (17 degrees F.), varying from 25 degrees A (45 degrees F.), in September, to 14 degrees A (26 degrees F.) in January and February. The greatest daily range was 23 degrees A (41 degrees F.) on September 10, and the smallest was 2 degrees A (3 degrees F.) on May 10. September and October were the warmest months, the mean temperature for October being somewhat higher than the average for that month. December was the coldest month. Frosts occurred mostly in December, when frost was reported on 11 mornings; the other 3 frosts reported were all in January.

The pressure of the water vapor of the atmosphere was generally less than 15 mb. (0.420 inch). Relative humidities were slightly higher than the average, being 89 per cent at both morning and evening observation hours. The mean of the saturation deficits for each day at the time of greatest strain on organisms was 7 mb. (0.26 inch), which is slightly more than the average of the 23 years of comparable observations of atmospheric moisture. The average saturation deficit at time of daily maximum temperature was greatest in October and November, 11 mb. (0.41 inch), and least in January, February, and March, 4 mb. (0.15 inch). The average cloudiness at the observation hours was 0.5; the greatest monthly average was 0.9 for the morning and 0.7 for the evening hour in July, which is about 50 per cent more than the average; November was the least cloudy month, 0.2 at each observation hour.

The weather by days was as follows: 44 per cent clear, 25 per cent partly cloudy, and 31 per cent cloudy. August had the greatest number of cloudy days (18), and November the smallest (3). June and October each had 22 clear days, and February had 6. Fog as defined by the international meteorological committee occurred on 28 days, with a maximum of 7 in June and a minimum of none in February. Velo cloud, or "high fog," occurred on about 50 other days, which is a rather large number. But one thunderstorm occurred during the year, about noon on February 16; a daytime thunderstorm is a very unusual occurrence on the California coast.

The total number of days with measurable precipitation was 87, which is about 30 per cent more than the average. The greatest number in any month was 19, in February. December, January, February, and May had more than the average number of rainy days, the number for May being nearly three times the average. There were 29 periods without rain between the first rain in autumn and the last in spring; of these 40 per cent lasted 2 days or less, 60 per cent 4 days or less, 80 per cent 6 days or less; the longest dry period, except the dry summer, was 25 days. Of the 30 periods of consecutive rainy days 30 per cent lasted 1 day, 50 per cent 2 days or less, and 80 per cent 4 days or less; the longest such period was 11 days.

The total precipitation for the year was 786 mm. (30.95 inches), which is 16 per cent more than the average. September, October, November, March, April, and June had less than the average amount; December, January, February, and May had more than the average. The precipitation of May was the heaviest recorded for that month; it was 134 mm. (5.26 inches), which is 418 per cent of the May average. The rainiest month was February, with 208 mm. (8.18 inches). August and June had no rain, and July had only a trace.

The greatest precipitation on any rainfall day was 36 mm. (1.40 inches) on December 16. The greatest amount in the 24 hours ending at an observation hour was 44 mm. (1.72 inches) to the morning observation on December 17. The average amount of precipitation per day with measurable precipitation was 9 mm. (0.35 inch); December had the greatest average, 12 mm. (0.42 inch). The average amount per day with significant precipitation was 10 mm. (0.39 inch); May and February had the highest averages, 13 mm. (0.51 inch).

With the exception of 0.5 mm. (0.02 inch), the rain was the result of more or less well-defined cyclones, of which 40 were recognized. The average precipitation per cyclone with rain was 19.4 mm. (0.77 inch). The rainiest cyclones were those of December 15–18 and January 26–30, each of which had 66 mm. (2.6 inches) of rain. The longest cyclone was 7 days in length, January 19–25. The study of precipitation by cyclones was made solely

with a view to assigning the rain to the proper cyclone; no attempt was made to study the cyclonic weather of Berkeley from any other point of view.

Practically all the wind was from a southerly or westerly direction, but 33 days having prevailing winds from the north and east. The amount of north and east wind was slightly greater at the observation hours. One day was recorded as calm, but no movement of wind was observed at 94 observation hours, 13 per cent of all observations. Summer wind conditions prevailed on 53 per cent of the days, varying from 100 per cent in July to 16 per cent in January. Winter wind conditions prevailed on 15 per cent of the days; the maximum was 39 per cent in December; the minimum was none in July and August.

TABLE 1.—*Meteorological summary, Berkeley, Cal., for the year ending June 30, 1915.*

[H = 100.6 m; H_b = 98.0 m; h_t = 1.5 m; h_r = 4.6 m; ϕ = 37° 52′ N.; λ = 122° 16′ W. 120th meridian time.]

Month.	Pressure.			Temperature.							Moisture.									
	Monthly mean.	Extremes.		Mean.					Extremes.		Dew point.		Relative humidity.		Vapor pressure.		Precipitation.		Cloudiness.	
		Maximum.	Minimum.	8 hrs. (8ᵖ).	20 hrs. (8ᵖ).	Maximum.	Minimum.	Monthly.	Maximum.	Minimum.	8 hrs. (8ᵖ).	20 hrs. (8ᵖ).	8 hrs. (8ᵖ).	20 hrs. (8ᵖ).	8 hrs. (8ᵖ).	20 hrs. (8ᵖ).	Total.	Maximum in 24 hours.	8 hrs. (8ᵖ).	20 hrs. (8ᵖ).
	mb.	*mb.*	*mb.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	%	%	*mb.*	*mb.*	*mm.*	*mm.*	*0–10*	*0–10*
July	1016.6	1019.9	1010.5	286	286	293	284	289	299	283	285	286	91	93	14.1	14.3	T	T	9	7
August	1015.9	1021.0	1010.5	287	286	293	285	289	300	283	285	285	89	93	14.2	14.1	0.0	0.0	8	6
September	1015.5	1023.3	996.6	288	287	295	284	290	307	282	284	286	83	80	13.4	12.5	0.5	0.5	6	2
October	1015.8	1023.3	1009.4	287	287	295	284	290	306	280	284	284	83	83	13.0	12.9	21.3	15.5	4	3
November	1019.0	1027.1	1002.7	283	285	294	281	287	301	278	280	281	84	85	10.3	10.6	10.9	5.6	2	2
December	1016.2	1027.7	1003.3	279	281	285	278	281	293	274	277	279	87	87	8.4	9.4	167.1	43.7	4	3
January	1017.3	1029.5	990.8	280	282	286	278	282	290	275	279	279	92	80	9.9	9.7	176.8	23.9	6	5
February	1015.6	1030.8	991.2	282	282	287	280	284	290	276	281	281	92	85	10.5	11.1	207.8	33.0	6	6
March	1018.4	1028.7	1006.4	284	285	292	281	287	303	278	282	283	90	90	11.7	12.2	46.5	18.8	4	4
April	1015.7	1023.3	1005.0	285	285	291	282	287	298	279	283	284	90	94	12.1	12.9	21.6	13.5	6	5
May	1015.0	1023.3	1003.3	287	286	291	282	287	302	278	285	284	89	92	14.2	13.3	133.6	37.3	5	4
June	1014.2	1024.3	1007.1	289	287	295	283	289	303	282	287	286	88	92	16.0	14.9	0.0	0.0	3	3
Year	1016.3	1030.8	990.8	285	285	291	281	287	307	274	283	283	89	89	12.3	12.3	786.1	43.7	5	5

Month.	Wind.										Number of days.												
	Prevailing direction.	Number of winds, 8 hrs. and 20 hrs.									Clear.	Partly cloudy.	Cloudy.	Precipitation.		Snow.	Frost.	Hail.	Dense fog.	Maximum temperature.		Minimum temperature 273° or below.	Electricity.	
		North.	Northeast.	East.	Southeast.	South.	Southwest.	West.	Northwest.	Calm.				0.2 mm. and over.	1.0 mm. and over.	T or more.				273° or below.	305° or above.		Thunderstorms.	Aurora.
July	SW.	0	0	0	15	28	5	8	2	4	8	18	5	0	0	0	0	0	1	0	0	0	0	0
August	SW.	1	0	0	6	22	21	4	3	5	7	15	9	0	0	0	0	0	4	0	0	0	0	0
September	S.	0	1	6	5	14	9	9	1	15	15	10	5	1	0	0	0	0	5	0	1	0	0	0
October	S.	1	3	6	5	16	9	3	1	18	19	5	7	4	2	0	0	0	1	0	2	0	0	0
November	SW.	9	1	6	5	10	6	7	2	8	22	5	3	4	4	0	0	0	3	0	0	0	0	0
December	SE.	7	6	3	18	8	9	4	5	2	14	3	14	14	14	0	11	0	1	0	0	0	0	0
January	N.	12	8	2	11	11	7	1	7	3	11	4	16	17	16	0	3	0	1	0	0	0	0	0
February	SE.	7	5	4	14	8	9	5	4	0	6	7	15	19	16	0	0	1	0	0	0	0	1	0
March	SW.	0	7	5	16	12	9	2	2	9	15	5	11	9	8	0	0	0	2	0	0	0	0	0
April	W.	4	9	5	2	9	15	6	6	4	9	8	13	5	5	0	0	0	2	0	0	0	0	0
May	W.	3	1	1	6	9	10	24	4	20	14	5	12	14	10	0	0	0	1	0	0	0	0	0
June	W.	1	0	0	7	6	10	29	1	6	22	7	1	0	0	0	0	0	7	0	0	0	0	0
Year	SW.	45	41	38	110	153	119	102	38	94	162	92	111	87	75	0	14	1	28	0	3	0	1	0

TABLE 2.—*Meteorological summary, Berkeley, Cal., for the 28 years, July 1, 1887, to June 30, 1915.*

From—	ϕ	λ	H	H_b	h_a	h_r	Hours of observation.	
							Civil time 120th meridian.	G. M. T. (civil).
			meters.	*meters.*	*meters.*	*meters.*		
July 1, 1887	37° 52′ N	122° 16′ W	102.4	96.6	2.1	6.4	7, 14, 21	15, 22, 5
Sept. 1, 1899	37° 52′ N	122° 16′ W	96.3	96.6	2.1	0.3	8, 20	16, 4
Oct. 1, 1899	37° 52′ N	122° 16′ W	100.6	96.6	2.1	4.6	8, 20	16, 4
July 1, 1912	37° 52′ N	122° 16′ W	100.6	98.0	1.5	4.6	8, 20	16, 4

Month.	Pressure.			Temperature.							Moisture.									
	Monthly mean.	Extremes.		Mean.					Extremes.		Dew point.		Relative humidity.		Vapor pressure.		Precipitation.		Cloudiness.	
		Maximum.	Minimum.	8 hrs.*	20 hrs.*	Maximum.	Minimum.	Monthly.	Maximum.	Minimum.	8 hrs.*	20 hrs.*	8 hrs.*	20 hrs.*	8 hrs.*	20 hrs.*	Mean.	Maximum in 24 hours.	8 hrs.*	2 hrs.*
	mb.	*mb.*	*mb.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	°*A.*	%	%	*mb.*	*mb.*	*mm.*	*mm.*	*0–10*	*0–10*
July	1013.5	1023.3	1001.7	288	288	294	285	289	309	279	285	286	87	85	14	15	0.5	11.6	6	5
August	1013.5	1021.3	1001.0	287	288	294	285	289	307	281	286	286	88	87	15	15	1.0	21.3	7	6
September	1013.8	1022.6	996.6	287	289	295	286	290	314	281	285	286	87	85	14	15	14.7	69.9	5	4
October	1015.9	1025.7	998.0	286	287	292	284	289	308	277	284	285	86	84	13	14	36.4	81.7	4	3
November	1018.2	1044.0	992.8	283	285	290	281	286	301	274	281	282	89	84	11	12	68.2	62.7	5	4
December	1018.2	1032.4	996.9	280	282	285	279	282	294	272	279	280	87	85	9	10	108.9	75.1	4	4
January	1019.0	1035.5	990.8	280	282	285	279	282	298	269	278	280	90	83	10	10	152.9	95.6	6	4
February	1018.6	1033.2	988.8	281	281	287	280	283	299	271	279	281	88	86	9	11	105.9	125.3	5	2
March	1017.2	1031.2	989.8	282	284	288	280	284	304	274	280	281	88	87	10	11	116.3	90.7	6	4
April	1016.9	1031.2	989.8	284	284	290	281	286	293	275	282	282	86	86	11	12	36.4	65.6	5	4
May	1015.2	1026.4	1001.7	286	286	292	283	287	307	277	284	284	85	86	13	13	32.2	57.1	5	4
June	1013.8	1024.3	998.3	288	288	294	284	289	312	279	285	285	84	85	14	14	5.3	16.7	5	4
Year	**1016.2**	**1044.0**	**988.8**	**284**	**286**	**290**	**282**	**286**	**314**	**269**	**282**	**283**	**87**	**85**	**12**	**13**	**678.7**	**125.3**	**5**	**4**

Month.	Wind.									Number of days.												
	Prevailing direction.	Number of winds, 8 hrs. and 20 hrs.								Clear.	Partly cloudy.	Cloudy.	Precipitation.		Snow.	Frost.	Hail.	Dense fog.	Maximum temperature.		Minimum temperature 273° or below.	Electricity.	
		North.	Northeast.	East.	Southeast.	South.	Southwest.	West.	Northwest.	Calm.				0.2 mm and over.	1.0 mm and over.	T or more.				273° or below.	305° or above.		Thunderstorms.	Aurora.
July	Not computed.	1	0	2	3	16	13	9	2	16	13	7	11	(†)	(†)	Not computed.	0	Not computed.	12	0	Not computed.	Not computed.	Not computed.	Not computed.
August		1	0	2	5	17	10	8	1	18	9	9	13	(‡)	(‡)		0		11	0				
September		2	1	2	5	10	6	6	2	26	13	8	9	2	1		0		7	0				
October		4	2	3	5	8	4	4	3	29	15	8	8	4	3		0		4	0				
November		5	4	5	5	7	3	2	3	26	15	6	9	7	5		4		4	0				
December		7	6	7	7	6	1	1	2	25	14	7	10	10	8		8		2	0				
January		4	5	6	9	9	2	1	3	23	11	8	12	10	11		8		2	0				
February		5	3	5	6	8	3	2	2	23	12	6	10	9	8		4		3	0				
March		6	2	3	6	10	5	4	4	22	12	7	12	10	9		3		2	0				
April		5	2	3	3	9	8	5	5	20	14	8	8	6	4		0		2	0				
May		3	1	3	4	11	8	8	4	20	13	8	10	5	3		0		2	0				
June		1	0	1	5	14	13	6	2	18	15	8	7	1	1		0		5	0				
Year		**44**	**26**	**42**	**63**	**125**	**76**	**56**	**33**	**265**	**156**	**90**	**119**	**64**	**53**	.....	**27**	.....	**56**	**0**	.....	.....	.....	.....

* Sept. 1, 1892, to June 30, 1915. †The total number of days in 28 years was $\geqq$0.2 mm, 9; $\geqq$1.0 mm., 3. ‡The total number of days in 28 years was $\geqq$0.2 mm., 9; $\geqq$1.0 mm., 3.

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR FEBRUARY, 1917.

EDWARD H. BOWIE, Supervising Forecaster.

[Dated: Weather Bureau, Washington, D. C., Mar. 20, 1917.]

During February, 1917, 12 well-defined LOWS were charted, and of these 4 were of the Alberta, 3 of the North Pacific, 2 of the South Pacific, 1 of the northern Rocky Mountains region, and 2 of the Central type. Eleven HIGHS crossed the United States, and of these 10 belonged to the Alberta type, and the other one had its origin on the eastern slope of the Rocky Mountains. The HIGHS and LOWS of the month exceeded the average in speed of movement, and the HIGHS in nearly all instances were well defined and many of them were of exceedingly high pressure with decided cold waves attending them. A marked feature in connection with the HIGHS was that all save one were of the Alberta type, while the LOWS belonged to five types, no one of which was predominant.

In the Alaskan area the pressure was above the normal at the beginning of the month and again after the 15th. Moreover, pressure above the normal prevailed over southeastern Alaska continuously during the month. Over the Aleutian Islands and northwestern Alaska the pressure was below the normal generally from the 3d to the 14th, inclusive. At Honolulu the pressure was below the normal from the 1st to the 6th and from the 15th to the 22d, but above the normal on other days except the 14th, the 26th, and the 27th. Over the western North Atlantic the pressure was near or slightly above the normal in the vicinity of Grand Turks and Bermuda, and decidedly below the normal off the coast of Newfoundland.

Because of the marked activity of HIGHS and LOWS during the month storm and cold-wave warnings were necessitated on many days. The prominent cold waves of the month occurred during the first decade and caused much damage to growing crops in the South Atlantic and Gulf States.

WASHINGTON DISTRICT.

Cold-wave warnings during February.—The severe cold wave which had reached the Mississippi Valley by the night of January 31 overspread the entire eastern half of the country during February 1–3. On the latter date the temperature fell to 16° at Jacksonville and below freezing throughout the Florida peninsula, Miami reporting 28°, the lowest of record at that station. This was the most severe freeze in Florida since February, 1899. Cold-wave warnings had been issued on January 30 and 31 for all sections east of the Mississippi River, except northern New England. On February 1 warnings were issued for northern New England and were repeated for all other States east of the Mississippi except upper Michigan. The following forecast was issued for Florida:

Partly cloudy and decidedly colder to-night and Friday. Severe cold wave in north portion to-night and in the peninsula Friday; probably freezing temperature Friday night to central Florida.

On the 2d the following forecast was issued for the same State:

Fair and colder to-night; severe cold wave in central and southern portions of the peninsula; temperature of 20° to 25° in central portion and close to freezing in extreme south portion.

The cold-wave warnings were also repeated for South Carolina and eastern and central North Carolina on the morning of the 2d.

During the night of February 3–4 a disturbance developed over the North-Central States and was central over southern Michigan at 8 a. m. of the 4th as a storm of marked intensity. At the same time an area of high pressure of great magnitude was advancing rapidly southeastward over the Northwestern States and the Plains States with the highest barometer reading 31.08 inches at Miles City, Mont. Cold-wave warnings were issued for all States east of the Mississippi River except upper Michigan, the western and northern portions of southern Michigan, northern New England, western New York, and Florida. Special afternoon reports showing a rapid decrease in pressure over the Southeastern States, warnings were issued for northern and central Florida. At 9:30 p. m. of the 4th warnings were issued for western New York and northern New England. These warnings were fully verified in nearly all sections except northern New England and New York. In Florida the warning was partially verified; however, freezing temperature and killing frost were reported as far south as Miami on the morning of the 6th.

On the evening of February 7 a disturbance was advancing eastward over the Lakes Region followed by a marked increase in pressure and much lower temperature over Manitoba and North Dakota. Cold-wave warnings were issued for the northern portion of northern New England, the interior of eastern New York, northern and western portions of Pennsylvania, western New York, Ohio, Indiana, and Michigan. On the following morning these warnings were extended over Kentucky, Tennessee, and West Virginia. On the 9th warnings were issued for southern New England, eastern New York, the Middle Atlantic States, the Carolinas, southern and extreme eastern Georgia, and extreme northeastern Florida. Warnings were also issued of frost or freezing temperature to the coast in Mississippi and Alabama, and frost in Florida to the 27th parallel. Practically all of the warnings issued on the 7th, 8th, and 9th were fully verified.

Pressure was falling over the South Atlantic and East Gulf States on the morning of the 11th, with abnormally high pressure and cold weather to the north and northwest. As it appeared probable that the pressure would rise with a considerable fall in temperature over the Southeastern States, cold-wave warnings were issued for southwestern Virginia, eastern Tennessee, the Carolinas, northern Georgia, Alabama, southern and central Mississippi, and frost warnings for southern Georgia and extreme northern Florida. These warnings were verified in Mississippi, were partially verified in Alabama and eastern Tennessee, and failed in the other States on ac-

count of cloudy weather continuing and northeasterly winds setting in.

Frost warnings that were issued on February 15 for the southern portions of Alabama and Mississippi, northwestern Florida, and southwestern Georgia were partially verified.

A storm of marked intensity moving rapidly eastward was central over Lake Superior on the morning of the 17th and was followed by a decided increase in pressure over Minnesota and the Dakotas. Therefore cold-wave warnings were issued on February 18 for Michigan, Indiana, Ohio, northwestern Pennsylvania, and western and extreme northern New York, and for the northern portions of Maine, New Hampshire, and Vermont. These warnings were fully verified only in Michigan and northern New England and were partially verified in New York. The high-pressure area moved directly eastward over the northern Lakes Region instead of southeastward as expected, so that the warnings south of the Great Lakes failed of verification.

There was a decided decrease in pressure during the night of February 22–23 over the Lakes Region, the Ohio Valley, and Tennessee, with a marked rise in pressure and much colder weather over the Plains States and the Missouri Valley. Cold-wave warnings were issued on the 23d for Michigan, Indiana, the western portions of Kentucky and Tennessee and northwestern Ohio, and on the 24th for the northern portions of Maine and Vermont. These warnings were verified only in upper Michigan, the northern portion of southern Michigan, and the northern portions of Maine and Vermont. During the remainder of the month no cold-wave warnings were issued except on the 27th for northern Vermont and extreme northern New York.

Storm warnings during February, 1917.—The storm warnings which were ordered on January 31 on the Gulf coast from Bay Saint Louis, Miss., to Cedar Keys, Fla., and on the Atlantic coast from Eastport to Jacksonville were continued on February 1 and were extended to Tampa on the west Florida coast and southward to Jupiter on the east coast. Warnings were again ordered continued on the 2d from Provincetown, Mass., to Jupiter, Fla., and were extended to Key West on account of the strong gradient over the Gulf of Mexico and the South Atlantic States. These warnings were fully verified, the highest velocity reported being 60 miles an hour from the northwest at Jacksonville, Fla., Savannah, Ga., and Block Island, R. I., during the 2d. On the morning of the 3d the warnings were continued from Sandy Hook, N. J., to Provincetown, Mass., westerly gales continuing until the morning of the 4th. On this morning a disturbance of marked intensity was centered over southern Michigan, moving rapidly eastward with a strong high-pressure area to the westward. Northwest storm warnings were ordered displayed from Eastport to Wilmington, and, afternoon special reports showing a marked decrease in pressure over the Southeastern States, northwest warnings were ordered displayed at 4 p. m. along the Gulf coast from Bay Saint Louis to Tampa, and were extended on the Atlantic coast southward from Wilmington to Jupiter. On the 5th the warnings were continued along the Atlantic coast from Hatteras to Eastport, the storm center being over Connecticut with a barometer reading of 28.96 inches at Hartford. These warnings were fully verified, the highest velocity reported being 72 miles an hour from the northwest at Block Island, while velocities of 60 to 68 miles an hour were reported from several points along the coast from Hatteras northward.

A storm of marked intensity was central over New Jersey on the morning of the 9th, with a strong gradient to the westward. Anticipating a further development of this storm northwest storm warnings were ordered at 10 a. m. from Eastport to Hatteras and were fully verified, the highest velocity reported being 64 miles an hour from the northwest at New York. The warnings were continued until sunset on the 10th, from Eastport to Sandy Hook.

On the morning of the 15th a disturbance was central over eastern Tennessee, with lowest pressure 29.64 inches. The 12-hour and 2-hour pressure changes, indicating an increase in the intensity of this storm, northeast storm warnings were ordered at 11 a. m. from Nantucket to New York and northwest warnings from Sandy Hook to Savannah. Northeast warnings were ordered at 3 p. m. along the New England coast north of Nantucket. While the storm increased in intensity as anticipated, the pressure did not increase materially in its rear, so that no high velocities were reported, except 56 miles an hour from the northwest at New York.

A barometric depression of great depth was advancing rapidly southeastward over the western Canadian Provinces on the morning of the 16th, and special reports from Minnesota during the day showing rapidly falling barometer over that State, the following advisory warning for Lake Michigan was issued at 4 p. m.:

> Increasing southeast to south winds, becoming strong and probably reaching gale force by Saturday morning. Storm of marked intensity moving rapidly southeastward toward Lake Michigan.

During the night of the 16–17th a velocity of 40 miles an hour from the southwest was recorded at Ludington, Mich., and 44 miles an hour at Green Bay, Wis. By 8 a. m. of the 17th the storm center was over Lake Superior, with a barometer reading of 29 inches at Marquette, Mich. Southwest storm warnings were ordered displayed at noon from Eastport to Delaware Breakwater, but the storm decreased greatly in intensity during the day and only fresh winds were reported along the North Atlantic coast.

On the morning of the 23d the pressure was high over the North Atlantic States, with a decided fall in pressure over the lower Lakes Region and the Ohio Valley. Southwest storm warnings were ordered from Delaware Breakwater to Eastport, but the only winds of gale force reported were 36 miles an hour at Portland, Me., and 40 miles at Nantucket Lightship.

A storm of marked intensity was central over the Lakes Region on the morning of the 26th, moving rapidly eastward, and southwest storm warnings were ordered displayed at 10 a. m. along the Atlantic coast from Delaware Breakwater to Eastport. These warnings were verified along the New England coast, the highest velocity reported being 52 miles an hour from the southwest at Nantucket.—*Charles L. Mitchell, Assistant Forecaster.*

WARNINGS FROM OTHER DISTRICTS.

Chicago district.—The cold weather of the closing days of January persisted, in the Chicago district, with more or less modification during the greater portion of the month, but there were a few warm days during the third decade.

The barometer was high and the cold intense in the Canadian northwest practically until the close of the month, so that the LOWS from the west were forced to take the central and southerly routes in passing eastward

from the Pacific. One after another of these LOWS crossed the country in rapid succession, causing a temporary rise in the temperature in the Middle States to be followed in turn by cold weather. At the same time the falls in temperature were not at all times general over the Rocky Mountains Region and the Eastern slope, because of the persistency of the Plateau HIGH during the first half of the month, and of the Pacific LOW during the latter period.

At the beginning of the month the temperature was not only unusually low but the pressure high in the northwest. A reading of 31.14 inches was noted at Battleford, while pressures exceeding 31 inches prevailed generally throughout Alberta and eastern Montana. The temperature at the same time was below zero as far south as Oklahoma and as far east as the middle Mississippi Valley. In anticipation of these extreme conditions warnings had been issued in the closing days of January.

Cold-wave warnings, more or less general, were issued on February 3, 16, and 17, while on February 7, 8, 10, 22, 25, and 26 they were ordered for limited areas. For the most part the limiting temperature required for verification was reached, except in the third decade following the period of abnormally high temperature with decided falls, without, however, reaching the low point.

Advices were sent to the stock interests to protect their cattle on the western ranges on February 17, 20, and 22, as the cold promised to be ushered in with strong winds and some snow.

Because of the rapid movement of the LOWS, the attendant precipitation was slight and mostly confined to the northern portion of the district. Drought continued in the Central Plains States with only slight interruption until the close of the month, and but little precipitation was forecast for that section.—*H. J. Cox, Professor of Meteorology.*

New Orleans district.—The month opened with a severe cold wave for which timely warnings had been issued. The temperature was 26° along the West Gulf coast on the morning of February 2. Another decided cold wave overspread the district on the 4th and 5th, for which timely warnings were issued. Cold-wave warnings were issued on the 11th for Louisiana, Arkansas, and the southern and extreme eastern portions of east Texas. These warnings were only partially verified because the high pressure moving eastward did not extend southward to the Gulf coast. Cold-wave warnings were issued on the 17th for Oklahoma, Arkansas, northern Louisiana, and the northern portion of eastern Texas, on account of an area of high pressure attended by cold weather over the Mississippi Valley and the Plains States which was expected to extend southward over the area covered by the warnings, but the high pressure did not move southward and the warnings failed of verification. Unseasonably warm weather prevailed over the district during the latter part of the month and the highest temperatures of record in February were recorded at several stations in the district.

Storm warnings were issued for the Louisiana coast on the 1st and for the Texas coast on the 4th and 11th, all of which were justified by subsequent conditions.

Fire-weather warnings were issued for Arkansas and Oklahoma on the 4th and 17th, and the winds forecast occurred.—*I. M. Cline, Forecaster.*

Denver district.—The first half of the month was marked by high pressure and low temperatures west of the Continental Divide. During the latter half stormy weather with considerable snow followed by high winds prevailed in Utah and adjacent portions of Arizona.

At 8 p. m. on the 3d mild temperatures prevailed in eastern Colorado, while an area of high pressure was moving southward across eastern Montana and cold-wave warnings were issued for northeast Colorado. The warnings were verified in the eastern portion of the area. Cold-wave warnings were repeated the following morning for northeast Colorado and extended to southeast Colorado, and were verified, except near the foothills. Mild temperatures again prevailed in eastern Colorado at 8 p. m. on the 16th, with high winds and increasing pressure in parts of Wyoming, Montana, and the Dakotas, and cold-wave warnings were issued for eastern Colorado and repeated the following morning. These warnings were justified, except near the foothills. Heavy snowfall warnings for Utah, northern Arizona, and central and southwest Colorado were distributed at 11:30 a. m. on the 17th. During the 24 hours ending 8 a. m. on the 18th over 8 inches of snow fell at Flagstaff, Ariz.; 5.5 inches at Durango, Colo.; and 4 inches in Utah, while during the 36 hours ending at 8 p. m. on the 19th the snowfall at Flagstaff was over 11 inches, at Durango over 9 inches, and over 6 inches in parts of Utah. On the evening of the 19th a low-pressure area of decided intensity appeared to be moving inland from the north Pacific, and warnings of high winds were included in the forecasts for the northern portion of the district. Warnings of high winds were repeated on the 20th and 21st. High winds occurred in Utah, with temperatures above freezing, and reports indicate that snowslides occurred on several dates in portions of Utah and Arizona, impeding railroad traffic locally. On the evening of the 22d temperatures in eastern Colorado ranged from 50° to 60° F. At the same time the pressure was relatively high, with zero temperatures, in eastern Montana. The cold area appeared to be spreading southward along the eastern slope of the Rockies, and cold-wave warnings were issued for eastern Colorado. While temperatures fell 15 to 17 degrees, with temperatures below freezing on the morning of the 23d, the warnings were not verified, as a moderate area of low pressure crossed the mountains into eastern Colorado. Freezing-temperature warnings were issued for southeast Arizona on several dates, and freezing temperatures occurred. Cold-wave warnings were issued in the evening of the 25th and repeated the next morning for eastern Colorado. One low center moved southward, as expected, but the course of the HIGH from the northwest was too far eastward. Temperature falls of 20 degrees or more were common, but no low temperatures occurred.—*Frederick W. Brist, Assistant Forecaster.*

Portland, Oreg., District.—February, 1917, was not as stormy as usual in this district. From the 6th to the 15th, and again on the 27th and 28th, the weather was controlled by high pressure areas. North Pacific LOWS of slight to moderate energy were the dominating factors from the 1st to the 4th, and from the 18th to the 22d. A South Pacific LOW influenced the weather in Oregon and in portions of Washington and Idaho on the 24th and 25th.

Southeast storm warnings were ordered on the 1st at Washington coast stations and at the mouth of the Columbia River, and southwest storm warnings were ordered on the 15th at Washington stations and at the mouth of the Columbia. Both sets of warnings were verified. On the 19th a southwest storm warning was ordered at Marshfield. It is not known whether this

warning was verified or not, but it is believed it was. Small-craft warnings were issued on the 19th to all stations, and on the 24th to Marshfield and at the entrance of the Strait of Juan de Fuca.

Live-stock warnings were telegraphed to 25 distributing points on the 19th, 21st, and 24th to cover a period of rain and snow with blustering winds. These warnings were verified at nearly all places, and the following unsolicited letter relating to the first one was received from the Twin Falls Commercial Club:

You certainly called the turn in yesterday's forecast, for snow began falling here at 3.30 a. m. and it continued until 2 p. m., giving us a total fall of more than 6 inches.—*J. McMillan, Secretary.*

The official in charge of the Weather Bureau station at Walla Walla, Wash., states:

From information I have been able to gather, mainly through Forest Supervisor J. M. Schmitz, the warnings were quite fully verified on the stock ranges of this district. About 2 feet of snow fell at intervals in the mountains during the period from the 19th to the 24th, inclusive. There were, however, no severe storms. Gusty winds occurred frequently, but they did not attain a very high velocity, and no severe temperatures were experienced. There was no loss of stock.

In Oregon, where the lambing season begins earlier, some losses occurred in Benton County, and if any were experienced elsewhere they were not reported.—*E. A. Beals, District Forecaster.*

San Francisco District.—Like the two preceding months, February opened fair and cold with killing frosts in all sections of California on the 1st and 2d, after which the weather moderated and no other injurious frosts occurred. Light rains occurred on the 11th in northern California, extending into southern California on the 12th. Rain began again in the north on the 16th, extending into southern California on the 17th and 18th. General rain began on the 18th and continued with but little interruption until the 26th. The forecast for rain on the 13th was not justified.

Northwest storm warnings were issued from Point Reyes to Eureka on the 16th, and advisory warnings were sent to the southern coast. Southwest warnings were issued from Port Harford to San Diego on the 17th, and from Point Reyes to Eureka on the 19th. Southeast warnings were issued from San Francisco to Eureka on the 21st, and again on the 23d, when they were extended to Santa Barbara and continued on the 24th. The warnings were all justified.—*G. H. Willson, District Forecaster.*

SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, FEBRUARY, 1917.

By ALFRED J. HENRY, Professor in Charge.

[Dated: River and Flood Division, Weather Bureau, Mar. 26, 1917.]

East Gulf and South Atlantic drainage.—In the Gulf and South Atlantic States, while there were a few heavy local rains, yet, in general, the rains were moderate and rarely continued more than 24 hours. The floods were likewise mostly local and of short duration, except in the case of the Santee of South Carolina, the Tombigbee of Alabama, and the Pearl of Mississippi, which streams continued in flood into March. Further details may be had from Tables 1 and 2.

Eastern drainage of Mississippi River.—The only floods of the month in this drainage were local and of little consequence. A light flood swell passed down the lower Ohio on the opening days of the month due to rains in the latter part of the preceding month. Large ice gorges that had formed in the Allegheny at Franklin, Pa., and near Parkers Landing went out on the closing days of the month. Backwater from these gorges caused some damage at both places, viz, $10,000 at Franklin and $5,000 at Parkers Landing.

Pacific drainage.—Flood stages were reached in a few instances in the Sacramento and San Joaquin Rivers, as shown in Table 4. The damage was small, and the floods were of short duration.

Recapitulation of flood damage.

	Dollars.
Eastern drainage of Mississippi	15,000
Pacific	3,200
Total	18,200

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

TABLE 1.—*Floods in South Atlantic Drainage during February, 1917.*

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Neuse	Neuse, N. C.	12.0	26	26	12.4	26
Pedee	Cheraw, S. C.	27.0	.....	.....	25.8	25
Cape Fear	Elizabethtown, N. C.	22.0	.....	.....	19.4	27
Santee	Rimini, S. C.	12.0	21	(*)	15.6	28
Do	Ferguson, S. C.	12.0	23	(*)	13.7	28
Catawba	Catawba, S. C.	11.0	24	24	11.0	24
Wateree	Camden, S. C.	24.0	25	26	25.3	26
Broad	Blairs, S. C.	14.0	24	24	14.0	24
Saluda	Pelzer, S. C.	7.0	24	24	7.8	24
Do	Chappels, S. C.	14.0	26	26	15.0	26
Broad (of Georgia)	Carlton, Ga.	11.0	20	21	12.6	25
Ocmulgee	Abbeville, Ga.	11.0	27	(*)	11.7	28

* Continued into March, 1917.

TABLE 2.—*Floods in East Gulf Drainage during February, 1917.*

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Alabama	Selma, Ala.	35.0	23	28	37.3	25
Coosa	Gadsden, Ala.	22.0	21	26	22.8	22
Do	Lock No. 4, Ala.	17.0	20	27	19.2	21
Etowah	Canton, Ga.	11.0	19	20	15.8	20
Do	....do....	11.0	24	24	11.8	24
Cahaba	Centerville, Ala.	25.0	.....	.....	23.3	21
Tombigbee	Demopolis, Ala.	39.0	20	(*)	52.1	28
Black Warrior	Tuscaloosa, Ala.	46.0	21	23	55.2	21
Chickasawhay	Enterprise, Miss.	21.0	.....	.....	19.6	17
Pearl	Edinburg, Miss.	21.0	.....	.....	20.3	24
Do	Jackson, Miss.	20.0	18	(*)	26.2	28
Do	Columbia, Miss.	18.0	18	23	19.0	19
West Pearl	Pearl River, La.	13.0	20	(*)	15.3	22

* Continued into March, 1917.

TABLE 3.—*Floods in the eastern Mississippi River Drainage during February, 1917.*

(Ohio Basin.)

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Allegheny	Franklin, Pa.	15.0	27	27	† 24.0	27
Do	Parkers Landing, Pa.	18.0	28	28	† 22.0	28
Kiskiminetas	Saltsburg, Pa.	8.0	24	24	† 8.9	24
Ohio	Henderson, Ky.	53.0	1	1	34.0	1
Do	Evansville, Ind.	35.0	1	1	36.0	1
Do	Mount Vernon, Ind.	35.0	1	1	35.7	1
Do	Shawneetown, Ill.	35.0	1	2	36.4	1
Green	Lock No. 2, Ky.	54.0	1	2	37.2	1
Tennessee	Knoxville, Tenn.	12.0	21	21	12.0	21
Do	Riverton, Ala.	32.0	24	26	32.7	24, 25
Clinch	Clinton, Tenn.	25.0	.....	.....	22.6	25

† Caused mainly by ice gorging in channel.

TABLE 4.—*Floods in Pacific Coast Drainage during February, 1917.*

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Sacramento	Red Bluff, Cal.	23.0	25	26	27.0	25
Do	Sacramento, Cal.	29.0	.....	.....	26.4	26
San Joaquin	Lathrop, Cal.	17.0	27	27	17.1	27
Kings	Piedra, Cal.	12.0	22	22	12.8	22
Mormon Slough	Bellota, Cal.	20.0	21	22	21.0	22

MEAN LAKE LEVELS DURING FEBRUARY, 1917.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., Mar. 5, 1917.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during February, 1917:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	602.42	580.49	571.35	245.08
Above or below—				
Mean stage of January, 1917	−0.36	+0.01	−0.33	−0.18
Mean stage of February, 1916	+0.01	+1.09	−0.64	−0.33
Average stage for February, last 10 years	+0.68	+0.62	−0.34	−0.57
Highest recorded February stage	−0.06	−2.23	−2.40	−2.59
Lowest recorded February stage	+1.66	+1.33	+0.72	+1.25
Average relation of the February level to—				
January level	−0.2	0.0	−0.1	+0.2
March level	+0.2	0.0	−0.1	−0.2

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL REPORTS FOR FEBRUARY, 1917.

W. J. HUMPHREYS, Professor in charge.

[Dated: Weather Bureau, Washington, D. C., April 3, 1917.]

TABLE 1.—*Noninstrumental earthquake reports, February, 1917.*

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		CALIFORNIA.								
1917.	*H. m.*		° ′	° ′			*M. s.*			
Feb. 1	5 18	Santa Maria	34 58	120 28	4	2	10	None		R. E. Collom.
9	15 28	San Jose	37 20	121 54	3	1	2	None		U. S. Weather Bureau.
		MINNESOTA.								
6	17 46	Red Lake	47 55	95 00	4	1	1 0	Rumbling		A. C. Goddard.

TABLE 2.—*Instrumental reports, February, 1917.*

[Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.]

[For significance of symbols see REVIEW for January, 1917, p. 26.]

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. J. W. Green.

Lat. 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants: V / T_0: E 10 16.7; N 10 15.4

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Feb. 20	.....	eP_N	19 47 02	10	.....	.....	.....	Preliminary phases uncertain. Times are more reliable for N–S. Drum motion on E–W appears irregular.
		eP_E	19 48 00	.....	.....	.....	.....	
		L_N	19 58 35	27	.....	.....	.....	
		L_E	19 59 28	18	.....	.....	.....	
		M_N	20 01 50	16	.....	5350	.....	
		M_E	20 02 17	14	700	.....	.....	
		C_N	20 04 25	12	.....	.....	.....	
		C_E	20 05 17	10	.....	.....	.....	
		F_E	20 46 00	.....	.....	.....	.....	
		F_N	20 51 00	.....	.....	.....	.....	

Arizona. *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat. 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants: V / T_0: E 10 13.9; N 10 19.1

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Feb. 20	.....	eP_E	19 36 10	4	.....	.....	.....	
		eP_N	19 36 13	4	.....	.....	.....	
		S_E	19 43 00	8	.....	.....	.....	
		S_N	19 43 30	8	.....	.....	.....	
		L_N	19 50 12	13	.....	.....	.....	
		L_E	19 50 20	10	.....	.....	.....	
		M_N	19 51 30	14	.....	320	.....	
		M_E	19 55 10	10	190	.....	.....	
		C_N	19 58 00	10	.....	.....	.....	
		C_E	19 59 00	8	.....	.....	.....	
		F_E	20 38 00	10	.....	.....	.....	
		F_N	20 44 00	8	.....	.....	.....	

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Mount Hamilton. Lick Observatory.*

Lat., 37° 20′ 24″ N.; long., 121° 38′ 34″ W. Elevation, 1,281.7 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Point Loma. Raja Yoga Academy.* F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two-component, C. D. West seismoscope.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Feb. 3	.....	.....	.....	.....	*300	*300	.....	Tremors recorded during 24 hours preceding 15^h on dates given.
16	.....	.....	.....	.....	*150	*300	.....	
27	.....	.....	.....	.....	*200	*400	.....	

* Trace amplitude.

California. *Santa Clara. University of Santa Clara.* J. S. Ricard, S. J.

Lat., 37° 26′ 36″ N.; long., 121° 57′ 63″ W. Elevation, 27.43 meters.

(*See* record of the Seismographic Station, University of Santa Clara.)

TABLE 2.—*Instrumental reports, February, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W Forstall, S. J.								
Lat., 39° 40′ 36″ N.; long., 104° 58′ 54″ W. Elevation, 1,655 meters.								
Instrument: Wiechert 80 kg., astatic, horizontal pendulum.								
Instrumental constants.....								
1917. Feb. 1	.....	.....	*H. m. s.* 19 39 ..	*Sec.*	.....	.....	.....	Wavelets, thickening of penmarks, especially on N–S.
	.....	.....	19 48 ..	.....	.....	.....	.....	
1	.....	.....	23 52 ..	.....	.....	.....	.....	Small irregular waves on N–S.
	.....	.....	23 59 ..	.....	.....	.....	.....	
2	.....	.....	1 20 ..	.....	.....	.....	.....	Recurrence of small irregular waves on N–S.
	.....	.....	1 23 ..	.....	.....	.....	.....	
3	.....	.....	0 30 ..	.....	.....	.....	.....	Wavelets, thickening of penmarks, especially on N–S.
	.....	.....	2 20 ..	.....	.....	.....	.....	
5	.....	.....	1 00 ..	.....	.....	.....	.....	Distinct but very irregular waves on N–S.
	.....	.....	1 32 ..	.....	.....	.....	.....	
9–10	.....	.....	.....	.....	.....	.....	.....	Activity at intervals during day on both components.
20	III_r	P.....	19 38 ..	.....	.....	.....	.....	Good record, but S can not be identified to a certainty.
		L_N.....	19 47 ..	15–20	.....	.....	.....	
		M_N.....	19 47 ..	20	.....	*9050	.....	
		L_E.....	19 49 ..	15–20	.....	.....	.....	
		M_E.....	19 50 ..	20	*8500	.....	.....	
		C_E.....	19 55 ..	.....	.....	.....	.....	
		C_N.....	19 56 ..	.....	.....	.....	.....	
		F.....	20 28 ..	.....	.....	.....	.....	

* Trace amplitude.

District of Columbia. *Washington. U. S. Weather Bureau.

Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters.

Instrument: Marvin (vertical pendulum), undamped. Mechanical registration.

	V	T_0
Instrumental constants..	110	6.4

1917.			*H. m. s.*	*Sec.*			*km.*	
Feb. 12	.....	eL_E...	10 05 40	20	.....	.....	.....	Record does not show on N–S.
		L_E.....	10 13 40	16	.....	.....	.....	
		F.....	10 30 00	.....	.....	.....	.....	
15	I_u.....	P.....	0 59 36	.....	.....	.....	7,640	
		S.....	1 08 38	.....	.....	.....	.....	
		L.....	1 16 12	14	.....	.....	.....	
		L.....	1 18 04	20	.....	.....	.....	
		L.....	1 30 24	20	.....	.....	.....	
		F.....	2 00 00	.....	.....	.....	.....	
20	III_r...	iP.....	19 34 09	.....	.....	.....	2,210	Amplitudes very large; pens went off sheet occasionally. From 19h 40m to 19h 46m amplitudes of from 4–8 cm.
		S.....	19 37 50	.....	.....	.....	.....	
		L.....	19 54 00 to 21 00 00	14	.....	.....	.....	
		F.....	21 35 00	.....	.....	.....	.....	F merges in succeeding quake.
20	I_r.....	P?.....	20 57 45	.....	.....	.....	2,110?	Amplitude of 5μ from 21h 4m to 21h 8m.
		S?.....	21 01 18	.....	.....	.....	.....	
		F?.....	21 20 ..	.....	.....	.....	.....	F in end of preceding quake.

District of Columbia. *Washington. Georgetown University.* F. A. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: Decayed diorite.

Instruments: Wiechert 200 kg. astatic horizontal pendulums, 80 kg. vertical.

	V	T_0	ε
Instrumental constants: E	165	5.4	0
N	143	5.2	0
Z	*80*	*3.0*	*0*

1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Feb. 15	.....	P.....	0 59 30	.....	.....	.....	.....	Microseisms present. S possibly 10–15 seconds sooner. No distinct maximum.
		S_E.....	1 09 02	.....	.....	.....	.....	
		S_N.....	1 09 03	.....	.....	.....	.....	
		eL.....	1 24 08	.....	.....	.....	.....	
		F.....	1 54 00	.....	.....	.....	.....	
20	.....	P_E.....	19 34 15	.....	.....	.....	.....	Time markings poor because of intensity of quake; hence possible error of 2–3 seconds.
		iP_N...	19 34 17	.....	.....	.....	.....	
		S_E.....	19 37 52	.....	.....	.....	.....	
		S_N.....	19 38 06	.....	.....	.....	.....	
		eL.....	19 38 34	.....	.....	.....	.....	
		M_E.....	19 40 22	8	*48,000	.....	.....	
		M_N.....	19 40 22	7	.....	*49,000	.....	Good record with large amplitudes also obtained on Bosch-Omori machine.
		M_E.....	19 41 08	13	*130,000	.....	.....	F last in second quake.
				VERTICAL.				
					A_E			
		iP.....	*19 34 15*	.....	.....	.....	.....	
		S.....	*19 37 54*	.....	.....	.....	.....	
		eL.....	*19 38 38*	.....	.....	.....	.....	
		M.....	*19 41 21*	*8*	**14,000*	.....	.....	
		M.....	*19 43 00*	*8*	**11,000*	.....	.....	
		F?.....	*20 57 00*	.....	.....	.....	.....	F in second quake.
20	.....	eN?.....	20 58 00	.....	.....	.....	.....	e and S doubtful because confused with preceding quake.
		eE?.....	20 58 06	.....	.....	.....	.....	
		S.....	21 04 07	.....	.....	.....	.....	
		eL.....	21 07 28	.....	.....	.....	.....	
		F.....	21 21 00	.....	.....	.....	.....	
				VERTICAL.				
		e.....	*20 58 32*	.....	.....	.....	.....	Phases confused with preceding quake.
		L.....	*21 07 14*	.....	.....	.....	.....	
		F.....	*21 13 00*	.....	.....	.....	.....	

* Trace amplitude.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neumann.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association.

	T_0
Instrumental constant..	18 6

1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Feb. 4	.....	L.....	11 06 30	.....	.....	.....	.....	
		M.....	11 08 00	.....	*100	.....	.....	
		F.....	11 19 00	.....	.....	.....	.....	
5	.....	L.....	12 49 48	.....	.....	.....	.....	
		M.....	12 56 00	.....	*200	.....	.....	
		F.....	13 10 00	.....	.....	.....	.....	
10	.....	L.....	17 28 00	.....	.....	.....	.....	
		M.....	17 29 24	.....	*100	.....	.....	
		F.....	17 31 00	.....	.....	.....	.....	

* Trace amplitude.

TABLE 2.—*Instrumental reports, February, 1917*—Continued.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 12	.....	P.....	9 13 12	.....	.....	.....	.....	
		S.....	9 20 54	.....	.....	.....	.....	
		L.....	9 27 48	25	.....	.....	.....	
		M.....	9 32 12	.....	*2,300	.....	.....	
		C.....	9 34 42	.....	.....	.....	.....	
		F.....	11 24 00	.....	.....	.....	.....	
12	.....	L.....	23 24 00	.....	.....	.....	.....	
		M.....	23 27 12	.....	*200	.....	.....	
		F.....	23 32 06	.....	.....	.....	.....	
15	.....	P.....	1 07 00	.....	.....	.....	.....	Tremors in end portion from $2^h\ 32^m$ to $2^h\ 48^m$, may be a seismic tremor.
		S.....	1 20 48	.....	.....	.....	.....	
		L.....	1 33 30	25	.....	.....	.....	
		M.....	1 38 30	.....	*1,900	.....	.....	
		C.....	1 44 18	.....	.....	.....	.....	
		F.....	3 32 00	.....	.....	.....	.....	
18	.....	L.....	1 44 00	.....	.....	.....	.....	
		M.....	1 45 18	.....	*100	.....	.....	
		F.....	1 50 00	.....	.....	.....	.....	
18	.....	L.....	1 56 12	.....	.....	.....	.....	
		M.....	2 04 00	.....	*100	.....	.....	
		F.....	2 20 00	.....	.....	.....	.....	
20	.....	L.....	3 32 12	.....	.....	.....	.....	
		M.....	3 37 54	.....	*200	.....	.....	
		F.....	3 42 00	.....	.....	.....	.....	
20	.....	P.....	19 51 30	.....	.....	.....	.....	
		L.....	20 04 30	30	.....	.....	.....	
		M.....	20 17 54	.....	*100	.....	.....	
		C.....	20 28 48	.....	.....	.....	.....	
		F.....	22 24 00	.....	.....	.....	.....	
21	.....	P.....	10 14 00	.....	.....	.....	.....	
		L.....	10 26 30	24	.....	.....	.....	
		M.....	10 31 30	.....	*300	.....	.....	
		C.....	10 35 24	.....	.....	.....	.....	
		F.....	10 48 30	.....	.....	.....	.....	
21	.....	L.....	14 26 18	.....	.....	.....	.....	
		M.....	14 30 06	.....	*300	.....	.....	
		F.....	14 43 00	.....	.....	.....	.....	
22	.....	P.....	9 36 30	.....	.....	.....	.....	
		S.....	9 44 00	.....	.....	.....	.....	
		L.....	9 56 42	24	.....	.....	.....	
		M.....	10 01 24	.....	*500	.....	.....	
		C.....	10 05 18	.....	.....	.....	.....	
		F.....	11 15 00	.....	.....	.....	.....	
25	.....	P.....	5 41 24	.....	.....	.....	.....	
		L.....	6 00 30	21	.....	.....	.....	
		M.....	6 03 18	.....	*400	.....	.....	
		M.....	6 27 00	.....	*400	.....	.....	
		M.....	6 32 42	.....	*400	.....	.....	
		C.....	6 35 00	.....	.....	.....	.....	
		F.....	6 56 00	.....	.....	.....	.....	
26	.....	L.....	9 20 30	.....	.....	.....	.....	
		M.....	9 22 48	.....	*100	.....	.....	
		F.....	9 34 00	.....	.....	.....	.....	

* Trace amplitude.

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Wiechert.

Instrumental constants.. {E: V 177, T_0 3.4, ϵ 4:1; N: V 205, T_0 3.4, ϵ 4:1}

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 20	.....	P.....	19 35 06	4–5	1	1	.....	Amplitude of P waves about 15 sec. later, 25 to 30 μ.
		S.....	19 39 32	10–12	.....	.....	.....	
		L_N?...	19 42 51	.....	.....	.....	.....	
		L_E?...	19 43 10	.....	.....	.....	.....	
		M_N....	19 44 07	10–15	.....	133	.....	
		M_E....	19 44 12	10–15	97	.....	.....	
		F.....	21 16 00	.....	.....	.....	.....	

Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodedetic Survey. George Hartnell.

Lat., 38° 44′ 00″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants.. {E: V 10, T_0 32; N: V 10, T_0 27}

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 15..	.....	eL_N...	1 24 30	22	.....	.....	.....	
		M_N....	1 30 46	20	.....	10	.....	
		C_N....	1 36 00	.....	.....	.....	.....	
20	.....	P_N....	19 34 10	3	.....	.....	.....	
		P_E....	19 34 14	3	.....	.....	.....	
		S_N....	19 37 50	4	.....	.....	.....	
		S_E....	19 37 53	4	.....	.....	.....	
		L_E....	19 40 11	18	.....	.....	.....	
		eL_N...	19 40 51	16	.....	.....	.....	
		M_E....	19 41 16	14	3,180	.....	.....	
		M_N....	19 42 20	14	.....	1,200	.....	
		C_E....	19 46 00	12	.....	.....	.....	
		C_N....	19 48 00	8	.....	.....	.....	
		F_E....	20 41 00	12	.....	.....	.....	
		F_N....	20 47 00	12	.....	.....	.....	

Massachusetts. *Cambridge. Harvard University Seismographic Station,* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants.. {E: V 80, T_0 23, ϵ 0; N: V 50, T_0 25, ϵ 4:1}

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 15	.....	*O*.....	*0 49 54*	.....	.....	.....	6,990?	P and S do not agree well with Ottawa and Georgetown.
		eP_N...	1 00 01	.....	.....	.....	.....	
		eP_E...	1 00 34	.....	.....	.....	.....	
		S_E?...	1 08 20	.....	.....	.....	.....	
		S_N?...	1 09 29	.....	.....	.....	.....	
		eL_E?..	1 17 53	22	.....	.....	.....	
		eL_E...	1 20 54	10	.....	.....	.....	
		eL_N...	1 23 21	.....	.....	.....	.....	
		eL_E...	1 31 32	20	.....	.....	.....	
20	.....	O_E....	*19 27 54*	.....	.....	.....	2,690	N–S record preferred, as there is doubt about setting of stylus on E–W.
		O_N....	*19 28 10*	.....	.....	.....	.....	
		eP_E...	19 34 37	.....	.....	.....	.....	
		iP_N...	19 34 53	.....	.....	.....	.....	
		S_E....	19 38 57	.....	.....	.....	.....	
		S_N....	19 39 15	.....	.....	.....	.....	
		eL_N...	19 42 —	.....	.....	.....	.....	
		eL_E...	19 43 26	.....	.....	.....	.....	

Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert 80 kg. astatic, horizontal pendulum.

Instrumental constants.. V 80, T_0 7, ϵ 5:1

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 20	III_T...	P.....	19 34 42	.....	.....	.....	2,400	
		S.....	19 38 36	.....	.....	.....	.....	
		L.....	19 39 36	.....	.....	.....	.....	
		F.....	20 57 00	.....	.....	.....	.....	

TABLE 2.—*Instrumental reports, February, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
New York. *Buffalo. Canisius College.* John A. Curtin, S. J.								
Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.								
Instrument: Wiechert, 80 kg., horizontal.								
Instrumental constants.. V 80, T_0 7, ϵ 5:1								
(Report for February, 1917, not received.)								
New York. *Fordham. Fordham University.* Daniel H. Sullivan, S. J.								
Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.								
Instrument: Wiechert, 80 kg.								
Instrumental constants.... E: V 72, T_0 7.2, ϵ 1.5:1; N: V 72, T_0 7.2, ϵ 3.8:1								
(Report for February, 1917, not received.)								
New York. *Ithaca. Cornell University.* Heinrich Ries.								
Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.								
Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).								
Instrumental constants..... E: V 13, T_0 22, ϵ 4:1; N: V 14, T_0 25, ϵ 4:1								
1917. Feb. 20	.....	P	*H. m. s.* 19 35 13	*Sec.* 4	.....	.....	.....	
		S_E	19 39 23	8	.....	.....	.....	
		S_N	19 39 24	7–14	.....	.....	.....	
		M_E	19 44 12	13	*57000	.....	.....	E–W pen went off drum.
		M_N	19 44 12	12	.....	*21000	.....	
		F_E	20 13 00	.....	.....	.....	.....	
		F_N	20 20 00	.....	.....	.....	.....	
* Trace amplitude.								
Panama Canal Zone. *Balboa Heights.* Isthmian Canal Commission.								
Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.								
Instruments: Two Bosch-Omori, 100 kg.								
Instrumental constants.. V 10, T_0 20								
1917. Feb. 5	.....	P_N	*H. m. s.* 6 09 14	*Sec.*	.....	.....	*km.* 233	Direction SW. or NE.
		P_E	6 09 16	.....	.....	.....	.....	
		L_N	6 09 40	.....	.....	.....	.....	
		L_E	6 09 42	.....	.....	.....	.....	
		M_E	6 09 42	.....	400	.....	.....	
		M_N	6 09 50	.....	.....	380	.....	
		F_N	6 14 26	.....	.....	.....	.....	
		F_E	6 14 28	.....	.....	.....	.....	
20	.....	P_N	19 32 14	.....	.....	.....	1,680	Direction unknown.
		P_E	19 32 19	.....	.....	.....	.....	
		S_E	19 34 10	.....	.....	.....	.....	
		S_N	19 35 14	.....	.....	.....	.....	
		L_E	19 36 43	.....	.....	.....	.....	
		M_E	19 37 02	.....	4,500	.....	.....	
		L_N	19 37 31	.....	.....	.....	.....	
		M_N	19 37 48	.....	.....	3,900	.....	
		F_E	20 15 00	.....	.....	.....	.....	
		F_N	20 18 00	.....	.....	.....	.....	
26	.....	P	3 57 54	.....	.....	.....	315	No record on N–S, clock stopped.
		L	3 58 28	.....	.....	.....	.....	
		M	3 58 30	.....	240	.....	.....	
		F	4 03 06	.....	.....	.....	.....	
Porto Rico. *Vieques. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. L. Adams.								
Lat., 18° 09′ N.; long., 65° 27′ W. Elevation, 19.8 meters.								
Instruments: Two Bosch-Omori.								
Instrumental constants.. E: V 10, T_0 17.5; N: V 10, T_0 18.0								
1917. Feb. 9	.....	P	*H. m. s.* 7 15 16	*Sec.* 3	.....	.....	*km.*	Local shock, not felt.
		M	7 15 30	3	20	20	.....	
		F_E	7 17 00	.....	.....	.....	.....	
		F_N	7 18 30	.....	.....	.....	.....	
12	.....	e_N	20 06 28	2	.....	.....	.....	
		e_E	20 06 31	2	.....	.....	.....	
		M	20 06 41	2	40	30	.....	
		F	20 10 00	.....	.....	.....	.....	
15	.....	e	0 57 00	.....	.....	.....	.....	
		M_E	1 18 00	20	10	.....	.....	
		M_N	1 19 30	20	.....	20	.....	
		F_N	1 32 00	.....	.....	.....	.....	
		F_E	1 38 00	.....	.....	.....	.....	
20	.....	P_E	20 32 35	7	.....	.....	.....	The stylus of N–S went off the sheet at 20h 39m 40s and did not free itself until 20h 50m 30s. Amplitude to edge of paper, 6,500 μ.
		P_N	20 32 40	8	.....	.....	.....	
		L_N	20 35 25	17	.....	.....	.....	
		L_E	20 35 29	20	.....	.....	.....	
		M_E	20 38 40	18	3,380	.....	.....	
		C_E	20 42 00	13	.....	.....	.....	
		F_E	22 35 00	.....	.....	.....	.....	
		F_N	22 45 00	.....	.....	.....	.....	
Vermont. *Northfield. U. S. Weather Bureau.* Wm. A. Shaw.								
Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.								
Instruments: Two Bosch-Omori, mechanical registration.								
Instrumental constants: E: V 10, T_0 15; N: V 10, T_0 16								
1917. Feb. 15	.....	e?	*H. m. s.* 0 59 30	*Sec.*	.....	.....	*Km.*	
		S?	1 08 27	.....	.....	.....	.....	
		F	1 20 00	.....	.....	.....	.....	
20	II_T	P	19 35 06	.....	.....	.....	2,960	
		S	19 39 46	.....	.....	.....	.....	
		L	19 43 20	20	.....	.....	.....	
		M_E	19 45 00	.....	2900	.....	.....	
		M_N	19 45 30	.....	.....	1900	.....	
		F	21 10 00	.....	.....	.....	.....	
Canada. *Ottawa. Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz.								
Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.								
Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80 kg. vertical seismograph.								
Instrumental constants: V 120, T_0 26								
1917. Feb. 12	.....	e?	*H. m. s.* 9 38 20	*Sec.*	.....	.....	km.	Strong microseisms mask phases on N–S.
		eL_E	10 00 00	20	.....	.....	.....	
		eL_N	10 05 00	20	.....	.....	.....	
		L_N	10 13 00	20	.....	.....	.....	
		L_E	10 17 00	18	.....	.....	.....	
		F	.....	.....	.....	.....	.....	
15	.....	O	*0 48 33*	.....	.....	.....	8,420	
		P	1 00 16	4	.....	.....	.....	
		S_N	1 09 57	.....	.....	.....	.....	
		S_E	1 09 58	.....	.....	.....	.....	
		eL	1 22 00	30	.....	.....	.....	
		L	1 26 00	30	.....	.....	.....	
		L	1 32 00	20	.....	.....	.....	
		L	1 37 00	17	.....	.....	.....	
		L	1 50 00	15	.....	.....	.....	
		F	2 15 00	.....	.....	.....	.....	

TABLE 2.—*Instrumental reports, February, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.

Canada. *Ottawa. Dominion Astronomical Observatory.* Earthquake Station—Continued.

			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 20	.....	*O*.....	*19 29 31*	.....	.....	.....	2,900	
		iP.....	19 35 18	.....	.....	.....	.....	
		eP.....	19 35 22	.....	.....	.....	.....	
		S.....	19 39 54	.....	.....	.....	.....	
		eL.....	19 43 42	.....	.....	.....	.....	
		M.....	19 45 18	12	350	200	.....	
		L_N.....	20 00 00	17	.....	.....	.....	
		L.....	{20 12 00 / 20 17 00}	11	.....	.....	.....	
		L_N.....	20 26 00	12	.....	.....	.....	
		L_N.....	20 45 00	12	.....	.....	.....	
		F.....	21 30 00	.....	.....	.....	.....	

Canada. *Toronto. Dominion Meteorological Service.*

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1 mm. swing of boom=0.50″.

			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. Feb. 12	.....	e?.....	9 48 00	.....	.....	.....	.....	
		L.....	10 02 30	.....	.....	.....	.....	
		eL.....	10 08 12	.....	.....	.....	.....	
		M.....	10 14 54	.....	*1300	.....	.....	
		F?.....	10 50 30	.....	.....	.....	.....	
12	.....	L?.....	11 20 18	.....	*50	.....	.....	Doubtful as to being seismic.
		F.....	11 31 30	.....	.....	.....	.....	
14	.....	L.....	5 40 06	.....	*100	.....	.....	
		F?.....	6 02 30	.....	.....	.....	.....	
15	.....	P.....	0 59 36	.....	.....	.....	.....	Beginning of P not well defined.
		S.....	1 08 30	.....	.....	.....	.....	
		L.....	1 26 18	.....	.....	.....	.....	
		L.....	1 32 30	.....	.....	.....	.....	
		M.....	1 44 36	.....	*400	.....	.....	
		L.....	2 36 12	.....	.....	.....	.....	
		F?.....	3 22 00	.....	.....	.....	.....	
20	.....	P?.....	19 36 00	.....	.....	.....	.....	Minute P waves.
		iS.....	19 39 24	.....	.....	.....	.....	Beginning very indistinct.
		iL.....	19 42 24	.....	.....	.....	.....	
		M.....	{19 44 30 / 19 45 30}	.....	*25000	.....	.....	Marked large disturbance.
		iL.....	20 10 18	.....	.....	.....	.....	Possibly in West
		iL.....	20 22 00	.....	.....	.....	.....	Indies of sub-
		F.....	21 50 00	.....	.....	.....	.....	marine origin.
21	.....	e.....	10 01 54	.....	.....	.....	.....	Slight thickenings.
		L.....	10 26 54	.....	.....	.....	.....	
		L.....	10 45 18	.....	*50	.....	.....	
		F.....	10 58 48	.....	.....	.....	.....	
21	.....	L.....	15 10 48	.....	*100	.....	.....	Thickening.
		F.....	15 19 30	.....	.....	.....	.....	
22	.....	eL.....	9 33 54	.....	.....	.....	.....	
		L.....	10 06 42	.....	*200	.....	.....	
		L.....	10 20 00	.....	.....	.....	.....	
		F.....	10 53 36	.....	.....	.....	.....	
25	.....	L.....	6 32 00	.....	.....	.....	.....	Minute thickenings at intervals.
		L.....	6 51 30	.....	*50	.....	.....	
		F.....	7 18 42	.....	.....	.....	.....	

* Trace amplitude.

Canada. *Victoria, B. C. Dominion Meteorological Service.*

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instrument: Wiechert, vertical; Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1 mm., swing of boom=0.54″.

			H. m. s.	*Sec.*	μ	μ	*km.*
1917. Feb. 12	.....	P.....	9 27 39	.....	.....	.....	3,470
		S.....	9 32 54	.....	.....	.....	.....
		L.....	9 38 03	.....	.....	.....	.....
		M.....	9 54 55	.....	*500	.....	.....
		F.....	10 18 17	.....	.....	.....	.....
14	.....	M.....	5 39 10	.....	*50	.....	.....
15	.....	P?.....	1 12 55	.....	.....	.....	.....
		S?.....	1 18 22	.....	.....	.....	.....
		L.....	1 25 39	.....	.....	.....	.....
		M.....	1 49 11	.....	*1,500	.....	.....
		F.....	2 54 34	.....	.....	.....	.....

* Trace amplitude.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.

Canada. *Victoria, B. C. Dominion Meteorological Service*—Continued.

			H. m. s.		μ	μ	*km.*	
1917.			VERTICAL.		A_E			
Feb. 15		*M*.....	*1 40 —*	*15*	†6	.....	.....	
20	.....	P?.....	19 36 57	.....	.....	.....	.....	
		iP.....	19 40 25	.....	.....	.....	.....	
		S.....	19 45 23	.....	.....	.....	.....	
		iS.....	19 48 51	.....	.....	.....	.....	
		iL.....	19 56 03	.....	.....	.....	.....	
		L.....	19 58 51	.....	.....	.....	.....	
		M.....	20 02 44	.....	*3000	.....	.....	
		L.....	20 16 03	.....	.....	.....	.....	
		F.....	21 08 41	.....	.....	.....	.....	
			VERTICAL.		A_E			
		P?....	*19 37 40*	*6*	.....	.....	.....	
		S?.....	*19 41 00*	*6*	.....	.....	.....	
		L.....	*19 45 40*	*10–12*	.....	.....	.....	
		M.....	*20 02 40*	*10*	†47	.....	.....	
21	.....	L.....	10 29 28	.....	.....	.....	.....	Probably part of long-distance quake.
		M.....	10 33 31	.....	*400	.....	.....	
		F?.....	10 37 29	.....	.....	.....	.....	
21	.....	M.....	14 53 21	.....	*200	.....	.....	
22	.....	L.....	9 59 23	.....	.....	.....	.....	
		M.....	10 03 51	.....	*300	.....	.....	
		F.....	10 15 15	.....	.....	.....	.....	
25	.....	P?.....	6 42 16	.....	.....	.....	.....	
		L.....	6 45 44	.....	.....	.....	.....	
		M.....	6 47 43	.....	*200	.....	.....	
		F.....	6 56 38	.....	.....	.....	.....	

* Trace amplitude. † True earth movement.

TABLE 3.—*Late seismological reports.* (*Instrumental.*)

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Wiechert.

Instrumental constants.. V T_0 ϵ {E 177 3.4 4:1 / N 205 3.4 4:1}

			H. m. s.	*Sec.*	μ	μ	*km.*	
1916. Nov. 21	.....	P_E.....	6 30 46	1–2	.....	.....	.....	N–S component out of order.
		S_E.....	6 34 58	2–15	.....	.....	.....	
		L_E.....	6 39 07	.....	.....	.....	.....	
		M_E.....	6 43 29	6–8	1	.....	.....	
		F.....	7 50 00	.....	.....	.....	.....	

(No record in December, 1916.)

1917. Jan. 30	.....	P_E.....	2 56 13	.....	.....	.....	.....	
		P_E.....	2 56 23	.....	.....	.....	.....	
		P_N.....	2 56 24	.....	.....	.....	.....	
		S_N.....	3 04 50	.....	.....	.....	.....	
		S_E.....	3 04 52	.....	.....	.....	.....	
		L_E.....	3 13 33	20–40	.....	.....	.....	
		L_N.....	3 14 22	20–40	.....	.....	.....	
		M_E.....	3 21 39	20	66	.....	.....	
		M_N.....	3 22 07	20	.....	20	.....	
		F.....	5 37 00	.....	.....	.....	.....	

SEISMOLOGICAL DISPATCHES.[1]

Murcia, Spain. (*Belated dispatch.*)

An earth movement in an east-west direction, which lasted for 3 seconds, was felt on January 28 at $22^h\ 35^m$, G. M. T., in this city and neighborhood. Great alarm was occasioned. (Special dispatch.)

Honolulu, H. I. February 24, 1917.

Intense activity, greater than known heretofore to any Hawaiians now living, is manifest in Kilauea volcano. (United Press.)

[1] Reported by the organization indicated and collected by the seismological station at Georgetown University, Washington, D. C.

SECTION VI.—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following books have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological and seismological work and studies:

Bauer, Louis Agricola.
Land magnetic observations, 1905–1910. Washington. 1912. iv, 185 p. front. plates. tables. 30½ cm. (Carnegie institution of Washington. Publication no. 175.)

Birge, Edward A.
Work of the wind in warming a lake. Notes from the Laboratory of the Wisconsin geological and natural history survey, 8. 24½ cm. (Excerpted from the Transactions of the Wisconsin academy of sciences, arts, and letters, v. 18, pt. 2, 1916, p. 341–391.)

Bowman, Isaiah.
The Andes of southern Peru: geographical reconnaissances along the seventy-third meridian. New York. 1916. viii, [21], 336 p. plates. diagrams (partly fold.) 7 fold. maps. 26 cm. [Climate, p. 121–181, with diagrams.]

Brooks, Charles Franklin.
New England snowfall. 25½ cm. (Reprinted from the Geographical review, v. 3, 1917, p. 222–240.)

Carpenter, Ford Ashman.
The aviator and the weather bureau. San Diego. 1917. 32 p. (incl. title-page) front. illus. diagrams. 17½ cm. Title-page in red and black.
Same; 2d ed. San Diego. 1917. 32 p. (incl. title-page) front. illus. diagrams. 17½ cm.

Flora, Snowden D.
Aridity of living rooms in cold weather. 23 cm. (In Bulletin of the Kansas state board of health, v. 13, no. 1, Jan. 1917, p. 9–11.) [See a later issue of this REVIEW.]

Keyes, Charles.
Syllabus of a course of lectures on geologic processes and geographic products in arid regions; rev. reprint. Socorro. 1914. 15 p. 23 cm.

Larde, Jorge.
El terremoto del 6 de Septiembre de 1915 y los demas terremotos de el Salvador. San Salvador. 1916. 71 p. 24½ cm. (At head of title: Observatorio meteorológico y sismológico de el Salvador. Cover title reads: Edición de la Revista de la Enseñanza.)

McAdie, Alexander George.
The new (absolute) thermometer scale with comparative values. Blue Hill Observatory. c1917. 1 sheet. 21½ cm.

McLean, Forman T.
A preliminary study of climatic conditions in Maryland, as related to plant growth. Baltimore. 1917. charts. tables. 26½ cm. (Reprinted from Physiological researches, v. 2, no. 4, Feb. 1917, p. 129–208. Carried out under the auspices of the Maryland state weather service, in 1914. Bibliography, p. 207–208.)

Marvin, Charles Frederick.
Doing the work of the United States government. The weather bureau. 30 cm. (Excerpted from Export American industries, March, 1917, p. 72–76.)

Mauritius. Royal Alfred observatory.
Annual report of the director of the Royal Alfred observatory for the year 1915. Mauritius. 1916. 12 p. tables. 33 cm.

Merrill, Paul W.
Registration of earthquakes at the Detroit observatory during the years 1914 and 1915. 30 cm. (Excerpted from the Publications of the Astronomical observatory of the University of Michigan, v. 2, 1916, p. 165–177.)

[Miami Conservancy district.]
Miami valley flood-protection work . . . Dayton. 1917. 28 p. (incl. title-page) illus. diagrams. 30½ cm. "Five articles published in Engineering news during January and February 1917."

Mysore. Meteorological dept.
Report on rainfall registration in Mysore for 1915, by N. V. Iyengar. Bangalore. 1916. 53 p. tables. 3 charts (partly fold.) 2 fold. maps. 32½ cm.

Plympton, George W[ashington].
The aneroid barometer: its construction and use; 12th ed. New York. 1917. 126 p. front illus. tables. 15 cm. (On cover: Van Nostrand's science series. no. 35.)

Via Raventós, José.
1. Observaciones prácticas sobre las heladas primaverales.
2. Pequeñas heladas de invierno. Tarragona. 1915. 35 p. (incl. title-page) 3 illus. 21½ cm. (At head of title: Cámara agrícola oficial de la Provincia de Terragona. Cover title: Las heladas tardías y las nubes artificiales. Modo de atenuar sus efectos.)

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

(C. FITZHUGH TALMAN, Professor in Charge of Library.)

The following titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

Engineering news. New York. v. 77. 1917.
Alter, J. Cecil. Bucking the big drifts in Wyoming. p. 396–399. (Mar. 8.)
Wells, James P. A safe method proposed for estimating minimum rainfall. p. 502–504. (Mar. 29.) [With chart showing "minimum-mean rainfall factors for stations in the United States with long records."]

Franklin institute. Journal. Philadelphia. v. 183. March, 1917.
King, Louis Vessot. On the acoustic efficiency of fog-signal machinery. p. 259–286.

Geographical review. New York. v. 3. March, 1917.
Huntington, Ellsworth. The geographical work of Dr. M. A. Veeder. p. 188–194. [With portrait and list of writings.]
Veeder, M[ajor] A[lbert]. The relation between solar and terrestrial meteorology. p. 194–211.
Brooks, Charles F. New England snowfall. p. 222–240. [With charts.]

Meteorological society of Japan. Journal. Tokyo. 36th year. February, 1917.
Otobe Kokichi. Demonstration of horizontal and intersecting rainbows. p. 3–6. [cf. this REVIEW, Jan., 1917, p. 5.]
Otobe, Kokichi. Equation of horizontal rainbows. p. 7–14.

Nature. London. v. 99. March 8, 1917.
Dines, W[illiam] H[enry]. The horizontal temperature gradient and the increase of wind with height. p. 24.

Royal society of Edinburgh. Proceedings. Edinburgh. v. 36. 1915–1916.
Davison, Charles. The Ochil earthquakes of the years 1900–1914. p. 256–287.

Scientific American. New York. v. 116. 1917.
The permanent aurora. p. 264. (Mar. 10.)
Flying kites to study weather. p. 327; 333. (Mar. 31.) [Discusses work of the Drexel station of the U. S. Weather Bureau.]

Scientific American supplement. New York. v. 83. 1917.
Thomson, Elihu. Inferences concerning auroras and certain physical facts regarding them. (Mar. 24.) [Repr. Proc. Nat. Acad. Sci.]
Brooks, Charles F. World wide changes of temperature. Can seasonal forecasts be made from a study of the weather of the world? p. 194–195. (Mar. 31.)

Scientific American supplement—Continued.

Fergusson, S. P. The value of high-level meteorological data. 1. In forecasting changes of temperature. p. 204–206. (Mar. 31.)

U. S. Public health service. Report. Washington. v. 32. February, 1917.

Trask, John W. Climate and tuberculosis. The relation of climate to recovery. p. 318–324.

Nature. Paris. 45 année. 24 février 1917.

Breton, A. Le pyranomètre, instrument de mesure du rayonnement. p. 128.

Revue du ciel. Bourges. 2 année. Février 1917.

Moreux, Th[eophile]. M. Alfred Angot. p. 84–87. [With portrait.]

Moreux, Th[eophile]. Comment on prévoit la neige. p. 88–89.

89756—17——3

Sociedad geográfica de Lima. Bolletin. t. 31. 1st trim. 1915.

Campbell, León. Observaciones meteorológicas tomadas en Arequipa. Observatorio de Harvard college. p. 102–110. [Daily observations for 1914.]

Società sismologica italiana. Bollettino. Modena. v. 20. no. 1. 1916.

Cavasino, Alfonso. Frequenza e distribuzione dei terremoti italiani nel ventennio 1891–1910. p. 9–31.

Guzzanti, C. Avvisatore sismico e registratore a carta continua. p. 32–35.

Palazzo, L[uigi]. Il Principe B. B. Galitzin. p. 51–56. [Obituary. With portrait.]

Società degli spettroscopisti italiana. Memorie. v. 6. Febbrario 1917.

Arctowski, Henryk. Notice sur les fluctuations de la constante solaire. p. 30–31.

SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF FEBRUARY, 1917.

P. C. DAY, Climatologist and Chief of Division.

[Dated: Weather Bureau, Washington, D. C., Apr. 9, 1917.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada and the prevailing direction of the winds are graphically shown on Chart VII, while the average values for the month at the several stations, with the departures from the normal, are shown in Tables I and III.

For February as a whole the barometric pressure averaged below the normal from the Lakes Region eastward, and also in the central Ohio Valley. Elsewhere it was above the average. The plus departures were not large, and likewise the minus departures were generally small, except in the New England States and to the northeastward, where they were rather pronounced.

At the beginning of the month relatively low pressure prevailed from the lower Lakes Region to the Gulf and over all sections to the eastward; elsewhere it was generally above the normal, being unusually high in the West and far Northwest. The high pressure soon overspread most sections and continued during the first decade, except in the region of the Great Lakes and to the eastward, where pressure was generally below the average. Except for the occasional passage of a low area, the pressure continued generally above the normal during the greater part of the second decade; however, toward the latter part generally low pressure overspread most sections and continued for several days, except in the Southeast, where the readings were near or slightly above normal. During the third decade several rather extensive high and low areas moved across the northern and central portions of the country, while in the South the pressure remained generally near the normal. The month closed with relatively high pressure throughout the central and northern districts and nearly normal pressure continued in the South.

The distribution of the HIGHS and LOWS was generally favorable for westerly and northwesterly winds in the New England and Middle Atlantic States, the Lakes Region, and also in the upper Mississippi and the middle and lower Missouri valleys, while southerly and southwesterly winds were frequent in the South Atlantic and Gulf States. Elsewhere variable winds prevailed.

TEMPERATURE.

The severe cold wave that covered the northern Plains region at the close of January extended southeasterly during the first few days of February, accompanied by rapid and extreme temperature falls in the districts east of the Rocky Mountains. On the morning of the 3d the temperature was below freezing throughout nearly every portion of the Florida mainland, light frost was reported on the east coast as far south as Long Key, while at Key West the lowest February temperature in 45 years, 44°, was equaled. Another sharp cold wave reached the Southern States on the 5th.

The first half of the month was colder than the normal in all districts east of the Rockies and warmer on the Pacific coast, while during the last half it was warmer than the average in central, southern, and eastern districts, and colder in the northwest.

For the month as a whole temperatures were lower than the normal in all northern districts, especially over the border States from Montana eastward, and in the middle Plateau. In the central and western Cotton Region and southern Plains States the average temperature was somewhat above the normal, while in the remaining districts it was close to the normal.

Freezing weather occurred at some time during the month in all portions of the country, except parts of California and Arizona, and the islands south of the Florida mainland. The minimum temperatures at numerous stations in the South were as low as or lower than for any previous February of record.

PRECIPITATION.

At the beginning of February light snow or rain occurred in the Lakes Region and to the eastward and southeastward, but during the next few days fair weather prevailed in most sections. About the middle of the first decade there was light precipitation in most northern States east of the Rocky Mountains, also in the Ohio Valley and to the eastward, and during the latter part of the decade precipitation occurred in the Lakes Region and the Atlantic States.

About the middle of the second decade rather heavy rains fell in portions of the eastern Gulf States and moderate amounts to the northeastward. During the next few days light rain or snow occurred in many portions of the northern border States, and during the last few days of the decade stormy weather, with light precipitation, prevailed in the southeastern and eastern portions of the country as well as in portions of the Pacific States. Much unsettled weather, with rather frequent but light snow or rain, occurred along the northern border during the first half of the third decade, and light rain fell in the Atlantic and east Gulf States the following few days. During this decade precipitation likewise occurred in most of the Pacific Coast States, with occasional heavy rains in portions of California. The month closed with generally fair weather in all districts, except in the Ohio Valley, where light rain or snow was falling.

For the month as a whole the precipitation was decidedly less than normal, except over the Southern Appalachian region and in portions of Alabama and Mississippi, where it was somewhat more. But little precipitation occurred in the Great Plains States, and it was decidedly below the normal in the lower Missouri and Ohio Valleys, the Lakes Region, and over most of Florida and Texas. In portions of Texas, southeastern New Mexico, and central Kansas there was no precipitation during the entire month.

SNOWFALL.

There was a lack of snow cover during the greater part of the month in most of the Central States and from the Ohio Valley eastward, but in the more northern of the winter-grain districts the cover was ample to protect the crops. The lower elevations of the mountain regions

of the West continued covered with snow throughout the month, which necessitated much feeding of stock.

At the close of the month the prospective water supply from the snow in the western mountain districts continued good in most central and northern districts, where large amounts of well-packed snow had accumulated. However, in New Mexico and portions of some adjoining States the accumulated depths of snow were below the averages, and the outlook for water was less promising.

RELATIVE HUMIDITY.

The relative humidity for the month as a whole was generally above the normal in the Rocky Mountain region and to the westward, also to the eastward in much of the northern third of the country. On the other hand the atmosphere was drier than usual for the season over most of the central and southern portions of the Rocky Mountains.

GENERAL SUMMARY.

The cold wave during the first few days of the month did much damage to truck crops in the Gulf and South Atlantic States, and also to peach buds in the Ozark district, in Arkansas, as well as in the Lakes Region and parts of the Ohio Valley. Much grape fruit was injured in the Southern States, and probably 50 per cent of the pineapples were destroyed in Florida. Citrus trees in northern and central Florida were defoliated, and the fruit was frozen on the trees, while many young trees were killed to the bank, but no general damage resulted in the southern part of the State.

The planting of corn, cotton, and sugar cane in portions of Florida, southern Texas, and the lower Mississippi Valley, and the replanting of truck crops in the Gulf and South Atlantic States made good progress under the warm and favorable weather during the latter part of the month, although it was too dry in much of Florida and too wet in some other Southeastern States for rapid advancement.

Winter wheat was considerably damaged from the Ohio Valley eastward because of the absence of snow cover, and there was a decided lack of moisture from the central and lower Missouri Valley southwestward to northern Texas, where the growth was poor. However, the northern part of the winter-wheat belt had a good snow cover and there was little or no damage. The crop was benefited by rain in California, but the condition was unsatisfactory in Washington.

Cold weather and snow caused some loss of stock in the Dakotas, Montana, Wyoming, and Utah, but stock was in good condition in Colorado, Idaho, and California. The conditions were favorable for ice harvest in all northern and central districts, and a plentiful supply was available for storage.

SEVERE LOCAL STORMS.

The following notes of severe storms have been extracted from reports from officials of the Weather Bureau:

California.—A storm of marked intensity prevailed over the entire State on February 24 and 25, 1917, and was accompanied by torrential rains and destructive winds, being most severe along the immediate coast. At Point Reyes Light a maximum wind velocity of 101 miles an hour was recorded, and at San Francisco windows and telephone wires were broken. At San Jose the storm was the indirect cause of the loss of three lives and an extraordinary amount of damage resulted from the wind and water, while at San Diego several buildings were unroofed. Railroad transportation was delayed by the excessive precipitation causing snowslides in the high Sierra and landslides in the Coast Range. At Helen Mine, Lake County, the total precipitation for the three days, February 23 to 25, amounted to 16.73 inches, and of this amount 10.35 inches fell within a period of 24 hours.

Alabama.—On the afternoon of February 23, 1917, tornadoes and severe local storms occurred at numerous places throughout central Alabama, doing considerable damage to property and killing several people. One of the most severe of the tornadoes originated about 1 p. m. near Whitsitt, Hale County, and passed north-northeastward over Rosemary and thence northeastward over the northwestern portion of Perry County, killing six persons. Another destructive tornado, moving northeastward, struck Stewartsville, Coosa County, and Hollins, Clay County, about 3:30 p. m. of the same day, killing 10 persons. The paths of these storms ranged from two or three hundred feet to nearly a mile in width.

Average accumulated departures for February, 1917.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	0–10.		P. ct.	
New England	21.5	−4.2	−3.3	2.40	−1.10	−1.40	5.7	+0.3	73	− 1
Middle Atlantic	30.3	−2.6	−0.1	1.99	−1.20	−1.50	6.0	+0.5	68	− 5
South Atlantic	47.1	−0.7	+4.9	2.49	−1.50	−2.30	4.6	−0.6	71	− 4
Florida Peninsula	65.2	−1.6	+3.3	0.40	−1.60	−4.00	2.9	−1.3	74	− 6
East Gulf	51.0	+0.2	+6.3	4.93	+0.20	+0.70	4.9	−0.6	71	− 4
West Gulf	51.6	+2.2	+6.4	1.27	−1.40	−2.90	4.6	−0.3	67	− 7
Ohio Valley and Tennessee	32.4	−3.2	−0.4	2.17	−1.40	+0.10	6.3	+0.1	71	− 4
Lower Lakes	19.0	−5.7	−5.9	1.39	−1.10	−1.10	6.9	+0.1	80	0
Upper Lakes	10.5	−8.7	−10.9	0.89	−0.90	−1.60	5.9	−0.4	83	+ 2
North Dakota	−0.6	−7.6	−9.6	0.66	+0.10	+0.10	5.8	+0.8	86	+ 5
Upper Mississippi Valley	18.1	−5.5	−6.4	0.48	−1.20	−1.40	5.4	+0.1	75	− 4
Missouri Valley	21.9	−2.5	+0.5	2.68	−0.80	−0.80	4.8	−0.4	72	− 4
Northern slope	19.4	−2.1	−3.8	1.04	+0.20	+0.10	6.5	+1.3	73	0
Middle slope	33.8	+1.4	+4.2	0.32	−0.40	−0.80	4.3	−0.2	59	− 8
Southern slope	47.6	+3.0	+5.3	0.40	−0.50	−0.80	3.6	−0.9	45	−17
Southern Plateau	43.5	−1.3	−4.1	0.35	−0.30	−0.20	3.1	−0.5	52	+ 4
Middle Plateau	28.7	−4.3	−16.0	0.80	−0.30	−0.70	5.0	−0.2	70	+ 3
Northern Plateau	30.5	−1.6	−5.4	1.28	−0.10	−0.70	7.8	+1.4	77	+ 2
North Pacific	40.3	−1.0	−2.2	3.86	−1.40	−4.10	8.1	+0.9	75	− 7
Middle Pacific	48.7	−0.3	−3.5	4.66	+0.40	−1.80	5.1	−0.5	71	− 6
South Pacific	53.3	+0.7	−1.7	3.60	+1.20	+0.90	4.4	0.0	70	− 1

WEATHER CONDITIONS ON THE NORTH ATLANTIC DURING FEBRUARY, 1916.

The data presented are for February, 1916, and comparison and study of the same should be in connection with those appearing in the REVIEW for that month. Chart IX (XIV–18) shows for February, 1916, the averages of pressure, temperature, and the prevailing direction of the wind at 7 a. m., 75th meridian time (Greenwich mean noon), together with notes on the locations and courses of the more severe storms of the month.

PRESSURE.

The distribution of the average monthly pressure, as shown on Chart IX, was unusual in some respects. The North Atlantic HIGH was central over the Azores, with a crest of 30.40 inches, somewhat higher than usual, while the Icelandic LOW was apparently near the normal in both intensity and position. The continental HIGH was too far west to exert much influence in the vicinity of the North American coast, where the average pressure varied from 29.9 inches, in the north, to 30.2 inches, near the central Gulf coast, which closely approximated the conditions as shown on the normal chart.

The lowest average barometric pressure for any 5-degree square was 29.61 inches, between latitudes 55°–60° and longitudes 5°–10° W., where the lowest individual reading was 28.76 inches on the 4th and the highest 30.50 inches on the 23d. The highest average pressure was 30.40 inches, in the square that includes the Azores, the lowest reading being 29.90 inches on the 23d and the highest 30.72 inches on the 8th. As the average pressure over the eastern part of the ocean, south of the 40th parallel, was slightly above the normal the gradients toward the higher latitudes were steeper than usual, while over the western divisions they were practically normal. Over the northern regions the pressure was considerably lower during the first decade of the month than during the second, while the mean for the last 9 days was higher. In the 5-degree square adjacent to the west coast of Scotland, where the lowest average monthly pressure occurred, the mean for the first decade was 29.32 inches; for the second, 29.47 inches; and for the last 9 days, 30.09 inches; the monthly average being 29.61 inches. In the square between latitudes 50°–55° and longitudes 25°–30°, the average for the first decade was 29.64 inches; for the second, 29.84 inches; for the last 9 days, 30.12 inches; and the monthly average, 29.86 inches. In the square between latitudes 35°–40° and longitudes 25°–30°, the figures were as follows: First decade, 30.44 inches; second, 30.58 inches; last 9 days, 30.15 inches; and the monthly average, 30.40 inches. In the square between latitudes 40°–45°, longitudes 65°–70°, they were: First decade, 30.07 inches; second, 29.99 inches; last 9 days, 29.71 inches; and monthly average, 29.93 inches. In southern waters there was, as usual, comparatively little change in the pressure during the month, although in the Gulf of Mexico the average for the last 9 days was somewhat below that for the first two decades.

GALES.

Gales were more frequent than usual over the steamer routes, although no winds of exceptionally high velocity were reported during the month. The greatest number of gales was encountered in the 5-degree square between latitudes 45°–50°, and longitudes 35°–40°, where they occurred on 14 days, a percentage of 48, while the normal percentage for that locality is 29. Eight of these gales occurred in the first decade, 5 in the second, and only 1 in the last 9 days. East of the 40th meridian in the vicinity of the steamer routes, nearly all of the heavy winds were encountered during the first 20 days of the month. There was also a marked decrease in the number toward the south, as in the square between latitudes 45°–50°, longitudes 15°–20°, they were observed on 12 days, while in the square adjoining it on the south, only one was reported during the month. In the western division the gales were more equally distributed, in the square between latitudes 30°–35°, longitudes 70°–75°, the first decade was entirely free, while 3 occurred in the second, and the same number in the last 9 days. The waters adjacent to Cape Hatteras had somewhat stormier weather than usual, as gales were reported from that region on 8 days, a percentage of 28, while the normal is 21.

On February 2 a well-developed depression was central near latitude 55° N., longitude 27° W., and winds of gale force, with hail, extended over the south and southwest quadrants. The movement of this disturbance toward the east was slight during the next 24 hours, although the storm area had increased in extent, reaching the steamer routes east of the 40th meridian, and accompanied by hail and snow. On the 4th the center of this LOW was near Stornaway, Scotland, where the barometer read 28.70 inches, and winds of from 40 to 60 miles per hour prevailed over practically the entire ocean north of the 40th parallel, while snow was reported from the western division and hail from the eastern. On the 5th and 6th the general conditions of wind and weather were about the same as on the 4th, although the center of the LOW was indeterminate on account of lack of observations.

On the 8th a LOW surrounded Newfoundland while moderate gales, with hail and snow, were encountered as far south as the 40th parallel, and similar conditions were recorded by a number of vessels in the central and northeastern part of the ocean. From the 9th to the 13th no unusual weather prevailed, although a few gales were encountered in widely scattered localities.

On the 14th a narrow tongue of low pressure extended in a nortneasterly direction from a point near latitude 43° N., longitude 56° W. The weather conditions between this point and the American coast were extremely variable, moderate to strong gales prevailing off Hatteras, while moderate winds with fog, as well as snow and hail, were reported near the 40th parallel. On the same day a second LOW of 29 inches existed between Scotland and the Shetland Islands, while a HIGH, with a crest of 30.60 inches, covered a large area between the Spanish coast and the Azores. The steep gradient between these two areas was responsible for heavy westerly and southwesterly winds in mid-ocean and along the European coast. On the 15th, a shallow LOW of 29.95 inches (I on Chart IX) was central near the Bermudas. Gales of from 40 to 50 miles prevailed over a limited area between the 70th meridian and the American coast, and one vessel reported fog in the northwest quadrant. Over the eastern division of the ocean the positions of both the high and low areas, together with the general conditions of wind and weather, had changed but little since the previous day. LOW No. I moved rapidly in a northeasterly direction, and on the 16th was near latitude 41°, longitude 56°. The second LOW of 28.70 inches now covered a large portion of the North Sea, while the HIGH remained practically stationary in both intensity and position. Gales still persisted over the greater part of the steamer lanes, although there was a limited area between the 20th and 35th meridians, where light to moderate winds prevailed.

On February 17 the approximate center of LOW No. I was near latitude 50° N., longitude 40° W., although reports were too scattering to plot its position accurately. Gales covered a large part of the area between the 40th and 50th parallels and the 30th and 45th meridians, while the winds over the eastern division had moderated to a marked extent. From the 19th to the 21st a well-developed LOW existed over eastern Canada and the adjacent waters. On the 19th heavy winds, attended by hail and snow, extended along the American coast as far south as the 30th parallel, and one vessel recorded both snow and fog. On the 20th, gales prevailed over a narrow area in the vicinity of the 40th parallel, between the

50th meridian and the American coast, but only winds of from light to moderate velocity were reported from the eastern section of the ocean.

On Chart III, "Tracks of Centers of Low Areas, February, 1916" (XLIV–14), published in the MONTHLY WEATHER REVIEW for that month, a LOW (II on Chart IX, XLV–18), is shown that first appeared in eastern Colorado on the evening of February 21. This LOW moved in an easterly direction, and on the morning of the 25th was central near Norfolk, Va. As a rule, the winds in that vicinity were from light to moderate, although one vessel reported a southerly gale of 48 miles an hour. On the 26th the center was near Boston, where the barometric reading was 28.80 inches. A number of vessels between that point and the 35th parallel encountered northwesterly gales of from 40 to 55 miles an hour, while southeasterly winds of about the same velocity were recorded near the 40th parallel, between the 55th and 60th meridians. On the same date a few vessels in the vicinity of latitude 48°, longitude 28°, reported moderate northwest gales, while the barometric readings ranged from 30 inches to 30.20 inches.

These vessels were in the northwest quadrant of a well-developed high, with a crest of 30.50 inches and central near latitude 40°, longitude 36°. On the 27th the center of the LOW (II on Chart IX) was near Chatham, Canada; the weather was unusually stormy along the American coast as far south as Florida, the storm area extending to the 65th meridian. On the 28th this LOW covered the Gulf of St. Lawrence, while moderate to strong gales, with snow, occurred over a limited territory between the 39th and 43d parallels. On the 29th the center of this disturbance was near St. Johns, Newfoundland; a number of vessels in the southwest quadrant recorded westerly and northwesterly gales, with snow, and heavy southwest winds prevailed along the American coast between the 30th and 35th parallels. This LOW increased in extent but decreased in intensity, and during the next 24 hours its easterly movement was only about 4 degrees of longitude. By March 1 the conditions of wind and weather had moderated considerably. The disturbance then changed its course toward the southeast, and on March 2 the center was near latitude 50° N., longitude 45° W., although it was impossible to locate it accurately on account of lack of observations.

TEMPERATURE.

The average temperature of the air over the ocean during February, 1916, was somewhat above the normal except in the vicinity of the west coast of Scotland and over the southern part of the Gulf of Mexico, where negative departures of 1 degree occurred. Over the waters adjacent to the American coast the averages were somewhat higher than usual, although they were slightly below the normal at a number of Canadian and United States Weather Bureau stations along the coast, as shown in the following table:

	°F.		°F.
St. Johns, N. F.	−0.8	Norfolk, Va.	−0.7
Sydney, C. B. I.	+0.1	Hatteras, N. C.	+0.6
Halifax, N. S.	−0.1	Charleston, S. C.	+0.3
Eastport, Me.	−2.0	Key West, Fla.	−1.2
Portland, Me.	−3.2	Tampa, Fla.	+0.8
Boston, Mass.	−2.5	New Orleans, La.	+0.3
Nantucket, Mass.	−2.8	Galveston, Tex.	+2.7
Block Island, R. I.	−3.1	Corpus Christi, Tex.	+2.7
New York, N. Y.	−3.0		

The lowest individual temperature reading of the month was 16° F., and occurred on the 12th and again on the 15th, in the 5-degree square that includes the east coast of Labrador. The highest temperature for the same square was 34° on the 2d, while the monthly mean was 24°.

FOG.

The amount of fog was considerably above the normal between the 40th and 45th parallels, and the 50th meridian and the American coast. In the eastern part of this region it was observed on 11 days, a percentage of 38, while the normal percentage is 20. Off the Newfoundland Banks the amount was slightly below the normal, and the steamer lanes were comparatively free.

SNOW AND HAIL.

Between the 40th and 45th parallels and the 50th and 70th meridians snow was reported on from 4 to 8 days, while for the same region hail was not reported on more than 3 days from any one 5-degree square. Over the western portion of the steamer routes hail was more frequently encountered than snow, while both were comparatively rare in mid-ocean.

Winds of 50 mis./hr. (22.4 m./sec.), or over, during February, 1917.

Station.	Date.	Wind.		Station.	Date.	Wind.		Station.	Date.	Wind.		Station.	Date.	Wind.	
		Velocity.	Direction.			Velocity.	Direction.			Velocity.	Direction.			Velocity.	Direction.
		Mis./hr.				*Mis./hr.*				*Mis./hr.*				*Mis./hr.*	
Atlanta, Ga.	4	63	nw.	Devils Lake, N. Dak.	16	60	n.	Mount Tamalpais—Continued.				Portland, Me.—Continued.			
Bismarck, N. Dak.	4	52	nw.	Duluth, Minn.	4	56	w.	Do.	24	54	se.	Do.	24	53	nw.
Do.	16	54	nw.	Do.	17	57	w.	Do.	25	73	w.	Providence, R. I.	5	59	nw.
Block Island, R. I.	2	66	nw.	El Paso, Tex.	18	63	w.	Nantucket, Mass.	5	70	sw.	Do.	10	60	w.
Do.	3	60	nw.	Erie, Pa.	23	50	se.	Nashville, Tenn.	4	58	nw.	Reno, Nev.	20	57	w.
Do.	5	72	w.	Do.	26	52	s.	New York, N. Y.	1	51	nw.	St. Louis, Mo.	4	52	nw.
Do.	9	58	w.	Grand Forks, N. Dak.	17	54	n.	Do.	2	56	nw.	St. Paul, Minn.	17	52	nw.
Do.	10	60	w.	Hatteras, N. C.	2	50	nw.	Do.	3	61	nw.	Sand Key, Fla.	2	60	n.
Buffalo, N. Y.	3	74	sw.	Do.	5	66	nw.	Do.	5	70	nw.	Sandy Hook, N. J.	3	53	w.
Do.	4	54	sw.	Do.	9	51	nw.	Do.	9	66	nw.	Do.	5	66	w.
Do.	5	58	w.	Huron, S. Dak.	4	52	nw.	Do.	10	60	nw.	Do.	9	56	w.
Do.	6	56	sw.	Jacksonville, Fla.	2	58	nw.	Do.	16	55	nw.	Do.	10	58	w.
Do.	7	60	sw.	Kansas City, Mo.	4	53	nw.	Do.	22	53	nw.	San Francisco, Cal.	24	52	s.
Do.	8	54	w.	Key West, Fla.	2	50	nw.	Norfolk, Va.	4	62	nw.	Savannah, Ga.	2	60	nw.
Do.	16	50	w.	Lander, Wyo.	24	64	sw.	Do.	5	60	nw.	Do.	4	52	nw.
Do.	19	60	sw.	Lexington, Ky.	4	60	sw.	North Head, Wash.	2	56	se.	Do.	5	54	nw.
Do.	20	54	sw.	Do.	26	52	sw.	Do.	15	54	nw.	Do.	9	50	w.
Do.	26	54	sw.	Lincoln, Nebr.	4	50	nw.	Do.	16	60	nw.	Sioux City, Iowa.	1	52	nw.
Burlington, Vt.	17	50	s.	Little Rock, Ark.	4	52	nw.	Oklahoma, Okla.	4	54	n.	Do.	4	69	nw.
Do.	23	64	s.	Louisville, Ky.	4	60	w.	Pierre, S. Dak.	4	55	nw.	Syracuse, N. Y.	23	52	s.
Do.	26	60	s.	Memphis, Tenn.	4	60	nw.	Point Reyes Light, Cal.	12	51	nw.	Tatoosh Island, Wash.	1	50	s.
Charlotte, N. C.	4	55	nw.	Modena, Utah.	25	51	sw.	Do.	16	101	nw.	Do.	2	61	se.
Chattanooga, Tenn	4	52	nw.	Mount Tamalpais, Cal.	16	68	nw.	Do.	17	84	nw.	Do.	15	62	w.
Cheyenne, Wyo.	1	50	w.	Do.	17	67	nw.	Do.	18	54	nw.	Do.	16	56	w.
Do.	3	60	w.	Do.	19	65	sw.	Do.	21	74	se.	Trenton, N. J.	5	52	w.
Do.	4	53	nw.	Do.	20	53	sw.	Do.	23	73	se.	Do.	9	53	nw.
Do.	16	61	w.	Do.	21	62	sw.	Do.	24	90	se.	Winnemucca, Nev.	20	50	sw.
Do.	25	53	w.	Do.	23	54	se.	Do.	25	71	se.	Do.	25	52	sw.
Do.	26	55	nw.	Mount Tamalpais—Continued.				Portland, Me.	10	50	sw.				
Columbia, S. C.	4	52	w.												
Columbus, Ohio.	4	56	w.												

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, February, 1917.

Section.	Temperature.								Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	48.9	+1.5	Pushmataha	85	22†	Valley Head	2	3	5.52	−0.12	Ozark	8.02	Robertsdale	3.00
Arizona	44.6	+1.5	Sentinel	84	24	Fort Valley	−11	1	1.08	−0.26	Carr's Ranch	4.25	3 stations	0.00
Arkansas	43.4	+1.7	Eldorado	89	26	4 stations	− 4	1†	1.93	−1.74	Mount Ida	4.80	Gravette	0.50
California	45.7	−2.8	Maricopa	95	26	2 stations	−20	1	6.25	+1.84	Helen Mine	27.05	3 stations	0.00
Colorado	26.5	+0.6	2 stations	77	25	Hermit	−38	1	0.84	−0.35	Columbine	4.11	Glen	T.
Florida	60.1	−0.2	Fort Meade	92	24	2 stations	13	3	1.75	−1.53	Bonifay	5.40	Fort Lauderdale	0.14
Georgia	48.5	+1.3	St. George	89	28	2 stations	0	3†	5.21	+0.04	Canton	9.45	St. George	1.91
Hawaii [January]	68.3	0.0	Mahukona	92	16†	Kealia, Kauai	44	31	8.83	+1.99	Honomu	25.34	Napoopoo	1.15
Idaho	25.1	−3.4	Guffey	60	24†	Stanley	−34	1	2.13	+0.13	Soldier Creek	6.93	Imus Bros. Ranch	0.47
Illinois	24.6	−2.8	3 stations	78	26†	Freeport	−20	2	0.51	−1.74	Shawneetown	2.18	Beardstown	0.01
Indiana	26.0	−2.5	Vevay	75	26	Howe	−23	12	1.14	−1.69	Jeffersonville	3.04	Auburn	0.15
Iowa	15.2	−5.3	Northboro	68	25	Inwood	−37	2	0.36	−0.79	Nora Springs	1.19	7 stations	T.
Kansas	31.9	+1.3	Utica	88	25	3 stations	−17	1†	0.04	−1.18	Saint Francis	0.58	12 stations	0.00
Kentucky	34.8	−0.6	Russellville	80	26	Farmers	− 9	5	3.51	−0.23	Alpha	8.20	Scott	1.62
Louisiana	55.2	+2.9	Angola	91	20	Kelly (near)	12	3	4.51	−0.44	Angola	8.50	Lakeside	1.86
Maryland-Delaware	31.6	+0.1	Western Port, Md	76	26	Oakland, Md	−18	13	2.19	−0.81	Deer Park, Md	4.70	Western Port, Md	1.09
Michigan	11.8	−7.3	St. Joseph	54	26	Humboldt	−39	10	0.64	−1.14	Benzonia	1.66	3 stations	0.11
Minnesota	2.1	−8.6	Winona	44	17	Roseau	−41	11†	0.70	−0.03	Red Lake Falls	1.76	Tracy	0.02
Mississippi	50.1	+2.1	3 stations	85	26†	Booneville	6	3	5.21	+0.28	Haziehurst	8.50	University	1.31
Missouri	30.5	−1.0	Koshkonong	83	26	Unionville	−22	2	0.41	−2.03	Caruthersville	2.76	Kidder	0.00
Montana	17.3	−3.9	Utica	64	6	Medicine Lake	−51	2	1.11	+0.34	Adel	4.29	2 stations	0.15
Nebraska	24.2	−0.2	Cambridge	84	25	3 stations	−33	2	0.24	−0.48	Ainsworth	1.10	9 stations	0.00
Nevada	30.5	−2.5	Las Vegas	75	24	San Jacinto	−34	1	1.01	−0.05	Marlette Lake	6.56	Imlay	T.
New England	18.6	−3.6	Rockport, Mass	54	10	Bloomfield, Vt	−39	13	2.19	−1.07	2 stations	4.10	Northfield, Vt	0.74
New Jersey	28.1	−1.9	Clayton	62	26	Culvers Lake	−17	13	1.95	−1.91	Cape May	2.80	Culvers Lake	1.18
New Mexico	36.5	−0.7	Carlsbad	86	26	Chama	−24	1	0.52	−0.29	Tajique (near)	4.46	11 stations	0.00
New York	18.4	−3.1	Westfield	58	1	North Lake	−42	12	1.97	−0.71	Westfield	4.63	Chazy	0.15
North Carolina	41.6	+0.4	2 stations	82	27†	Highlands	−12	3	3.34	−1.04	Highlands	9.13	Beaufort	0.81
North Dakota	−0.5	−8.4	Bowman	61	6	Taylor	−48	2	0.64	+0.15	McHenry	1.59	Bowman	T.
Ohio	25.4	−2.0	2 stations	75	26	2 stations	−21	12	1.43	−1.32	Ironton	3.81	Oak Harbor	0.28
Oklahoma	39.9	+0.8	Cloud Chief	94	25	Hooker	− 7	2	0.65	−0.66	Hugo	1.86	Newkirk	T.
Oregon	35.0	−2.4	Brookings	77	15	Blitzen	−25	1	3.33	−1.13	Golden Falls	8.86	Umatilla	0.53
Pennsylvania	25.6	−1.8	3 stations	68	26	2 stations	−29	13	1.46	−1.20	Hyndman	3.37	Milford	0.35
Porto Rico	72.3	−1.0	Naguabo	92	7	Aibonito	44	2†	1.90	−0.71	Rio Grande (El Verde)	4.56	3 stations	0.00
South Carolina	47.3	+0.4	Walterboro	87	28	Mountain Rest	− 2	3	4.11	−0.32	Liberty	8.35	Georgetown	0.60
South Dakota	11.0	−6.2	Ardmore	61	25	2 stations	−45	2	0.53	−0.04	Faulkton	2.12	4 stations	T.
Tennessee	40.0	+0.4	Arlington	81	26	Erasmus	−10	3	3.27	−1.17	Copperhill	6.01	Arlington	0.95
Texas	52.7	+2.7	Eagle Pass	101	21	Stratford	− 5	2	0.95	−1.02	San Augustine	5.67	24 stations	0.00
Utah	25.8	−3.9	Moab	75	25	Blacks Fork	−42	1	1.29	0.00	Logan	4.51	Hanksville	0.00
Virginia	35.9	−0.1	Ivor	79	27	Burkes Garden	−11	3	2.32	−0.85	Burkes Garden	5.29	Ivor	1.01
Washington	33.3	−1.4	Mottinger	66	5	2 stations	−13	27†	2.29	−1.16	Forks	11.76	Neppel	0.10
West Virginia	31.0	−0.9	Philippi	80	26	2 stations	−14	5	3.29	+0.14	Pickens	7.73	New Cumberland	1.26
Wisconsin	6.8	−8.6	Muscoda No. 3	45	16†	Hatfield	−44	12	0.78	−0.44	Kewaunee	2.20	Brodhead	0.10
Wyoming	20.2	−0.2	Burns	65	25	Cokeville	−44	1	1.07	0.00	Moran	6.56	2 stations	0.00

† Other dates also.

DESCRIPTION OF TABLES AND CHARTS.

[See MONTHLY WEATHER REVIEW, January, 1917, p. 40.]

TABLE I.—*Climatological data for Weather Bureau stations, February, 1917.*

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.											Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles.*							*0–10*	*In.*	*In.*
New England.							**21.5**	**−4.2**										**73**	**2.40**	**−1.1**									**5.7**		
Eastport	76	67	85	29.74	29.82	−0.16	17.6	−3.8	43	27	26	−15	3	9	31	16	10	70	2.79	−0.8	11	8,495	w.	49	ne.	9	11	7	10	5.4	21.2	3.5
Greenville	1,070	6	....	28.60	29.83	.....	9.1	.....	37	24	21	−24	3	−3	42	....	....	....	1.90	.....	7	.....	.....	.....	.....	.....	16	2	10	....	19.0	39.0
Portland, Me.	103	82	117	29.76	29.89	− .13	19.3	−4.5	50	27	28	−13	3	10	28	17	10	68	3.35	−0.3	12	10,162	nw.	66	nw.	5	11	8	9	4.9	17.3	4.7
Concord	288	70	79	29.57	29.90	− .14	18.5	−5.1	48	27	29	−13	3	8	34	....	....	....	1.50	−1.8	9	4,138	nw.	29	nw.	5	10	9	9	5.0	11.0	7.0
Burlington	404	11	48	29.45	29.98	− .11	11.7	−6.2	40	26	21	−18	12	2	33	....	....	....	1.60	+0.2	8	9,249	s.	64	s.	23	7	11	10	5.9	10.2	9.5
Northfield	876	12	60	29.91	29.91	− .13	11.8	−5.4	49	27	25	−27	13	−1	43	9	6	83	0.74	−1.5	4	4,893	n.	27	sw.	26	6	9	13	6.5	7.4	17.0
Boston	125	115	188	29.78	29.92	− .12	25.8	−2.2	53	27	34	− 3	3	18	28	23	17	68	2.67	−0.8	11	8,045	w.	39	w.	3	12	8	8	4.9	8.9	....
Nantucket	12	14	90	29.89	29.90	− .14	27.6	−5.0	49	26	34	6	12	21	24	26	22	80	2.96	−0.2	13	11,762	nw.	70	sw.	5	6	11	11	6.4	7.1	0.2
Block Island	26	11	46	29.89	29.92	− .14	27.4	−3.8	48	26	34	3	13	21	25	25	21	77	2.70	−1.6	10	15,150	nw.	72	w.	5	7	5	16	6.8	4.6	T.
Narragansett Pier	....	9	....	.....	.....	.....	24.1	−4.2	42	26	30	−3	13	18	29	....	....	....	4.10	.....	10	.....	sw.	.....	.....	.....	14	5	9	....	7.5	....
Providence	160	215	251	29.73	29.92	− .13	25.0	−4.0	52	27	33	−2	13	17	27	23	17	69	1.97	−2.4	9	10,171	nw.	60	w.	10	7	11	10	5.5	6.3	....
Hartford	159	122	140	29.76	29.94	− .12	23.2	−4.0	48	27	31	−4	13	15	29	21	16	72	2.20	−1.4	10	5,765	nw.	36	nw.	10	8	9	11	6.1	12.4	T.
New Haven	106	117	155	29.83	29.95	− .12	25.8	−2.5	51	27	34	−2	13	18	25	23	18	72	2.16	−1.6	15	6,573	nw.	45	nw.	5	9	8	11	5.6	8.6	....
Middle Atlantic States.							**30.3**	**−2.6**										**68**	**1.99**	**−1.2**												
Albany	97	102	115	29.84	29.95	−0.12	20.3	−3.3	45	27	29	−12	13	12	27	18	13	73	2.41	−0.1	11	5,912	nw.	33	s.	26	9	11	8	5.4	15.0	T.
Binghamton	871	10	69	28.98	29.95	− .13	20.3	−4.4	50	26	30	−12	13	11	34	....	....	....	0.81	−1.1	11	3,163	nw.	20	nw.	1	4	8	16	7.3	5.6	T.
New York	314	414	454	29.61	29.97	− .11	27.8	−2.9	55	27	36	0	13	19	29	24	16	61	1.70	−2.0	11	13,965	nw.	70	nw.	5	4	14	10	6.5	12.2	3.6
Harrisburg	374	94	104	29.60	30.02	− .07	28.2	−1.7	57	26	36	1	13	20	25	24	16	64	2.38	−0.3	11	5,779	nw.	36	sw.	4	8	10	10	5.5	14.1	6.0
Philadelphia	117	123	190	29.87	30.00	− .10	31.4	−1.4	60	26	40	3	13	23	29	28	22	70	2.20	−1.2	9	8,074	nw.	40	nw.	9	6	10	12	6.1	8.4	2.0
Reading	325	81	98	29.64	30.01	.....	28.5	.....	57	26	37	0	13	20	29	25	18	67	1.74	−1.8	11	6,032	nw.	34	nw.	4	8	6	14	6.5	11.1	5.2
Scranton	805	111	119	29.08	29.98	− .10	24.1	−2.8	53	26	32	−5	13	16	32	22	17	76	1.84	−0.9	11	5,365	sw.	31	sw.	23	6	11	11	6.5	8.4	....
Atlantic City	52	37	48	29.95	30.01	− .10	30.4	−2.6	59	27	38	1	13	23	31	27	21	71	2.43	−0.8	13	6,141	nw.	30	nw.	5	4	14	10	6.1	6.2	....
Cape May	18	13	49	30.01	30.03	− .08	31.2	−2.9	57	27	38	4	13	24	28	29	....	....	2.80	−0.5	12	7,674	nw.	38	nw.	5	8	10	10	5.4	1.6	0.1
Sandy Hook	22	10	57	29.94	29.97	.....	27.8	.....	52	26	34	4	13	21	27	25	20	74	2.57	.....	12	12,474	nw.	60	w.	5	6	15	7	5.9	12.0	2.8
Trenton	190	159	183	29.77	29.98	.....	28.5	.....	59	26	37	0	13	20	29	25	18	69	1.47	−1.7	12	9,383	nw.	53	nw.	9	7	9	12	6.5	7.6	2.7
Baltimore	123	100	113	29.89	30.03	− .08	32.2	−2.4	64	26	40	4	13	24	30	28	20	63	1.75	−1.8	10	5,104	nw.	30	sw.	26	9	7	12	5.6	6.6	0.5
Washington	112	62	88	29.90	30.02	− .09	32.8	−1.7	66	26	42	2	13	24	26	28	20	62	1.97	−1.4	9	6,084	nw.	44	nw.	5	12	4	12	5.4	2.5	....
Lynchburg	681	153	188	29.27	30.04	− .07	36.9	−1.3	73	27	47	2	5	26	31	32	26	67	1.66	−1.8	8	6,574	w.	40	nw.	4	8	11	9	5.6	0.7	....
Norfolk	91	170	205	29.95	30.06	− .05	38.8	−3.0	74	27	48	8	5	30	32	34	28	69	1.88	−1.9	10	11,350	w.	62	nw.	4	9	9	10	5.5	0.1	....
Richmond	144	11	52	29.88	30.04	− .07	37.6	−2.3	75	27	48	4	5	28	35	32	26	67	2.28	−0.8	12	6,947	sw.	46	nw.	4	6	9	13	6.1	0.8	....
Wytheville	2,203	49	55	27.60	30.07	− .05	32.0	−3.1	68	26	42	−6	5	22	46	28	23	74	2.56	−1.5	11	6,724	w.	33	w.	5	8	7	13	6.2	4.4	....
South Atlantic States.							**47.1**	**−0.7**										**71**	**2.49**	**−1.5**									**4.6**			
Asheville	2,255	70	84	27.66	30.10	−0.03	37.4	−1.1	72	27	49	−5	3	26	47	32	25	69	2.21	−2.4	12	7,390	nw.	39	n.	4	9	10	9	5.1	2.1	....
Charlotte	773	153	161	29.22	30.08	− .04	42.9	−1.2	74	27	53	7	5	33	30	37	31	70	3.78	−0.6	12	8,655	sw.	55	nw.	4	14	4	10	4.7	0.2	....
Hatteras	11	12	50	30.06	30.07	− .04	44.0	−2.6	63	24	52	15	3	36	37	40	37	80	1.23	−3.2	11	12,158	sw.	66	nw.	5	11	9	8	5.1	0.1	....
Manteo	12	5	43	.....	.....	.....	42.4	.....	74	27	53	12	3	32	....	....	....	....	1.90	.....	5	.....	ne.	.....	.....	.....	13	3	12	....	T.	....
Raleigh	376	103	110	29.66	30.07	− .04	42.2	−1.1	78	27	52	6	5	32	33	37	31	69	3.19	−1.2	12	6,422	sw.	48	w.	4	10	10	8	5.1	0.9	....
Wilmington	78	81	91	30.01	30.10	− .02	47.6	−0.1	80	28	58	13	3	37	39	42	36	72	1.18	−2.2	8	6,301	w.	42	w.	5	14	6	8	4.6	T.	....
Charleston	48	11	92	30.08	30.13	+ .01	50.8	−0.9	78	28	60	12	3	41	33	44	39	72	2.07	−1.3	8	8,112	sw.	43	w.	5	16	7	5	3.3	T.	....
Columbia, S. C.	351	41	57	29.71	30.10	− .01	47.9	+0.1	79	27	58	9	3	38	32	40	32	59	3.07	−1.5	8	6,929	w.	52	w.	4	11	10	7	4.4	T.	....
Augusta	180	62	77	29.92	30.11	− .01	49.0	0.0	80	27	60	9	3	38	32	44	39	76	3.40	−1.0	12	5,289	sw.	39	nw	4	12	5	11	5.0	T.	....
Savannah	65	150	194	30.07	30.14	+ .02	52.7	+0.2	83	28	63	13	3	42	30	46	41	72	3.32	0.0	9	10,243	sw.	60	nw.	2	9	11	8	5.1	T.	....
Jacksonville	43	200	245	30.12	30.17	+ .05	56.8	−0.1	82	19	67	16	3	46	32	49	45	75	1.46	−2.0	6	9,164	sw.	58	nw.	2	14	11	3	3.9	0.0	....
Florida Peninsula.							**65.2**	**−1.6**										**74**	**0.40**	**−1.6**									**2.9**			
Key West	22	10	64	30.13	30.15	+0.08	69.2	−1.6	82	1	75	44	3	63	22	63	60	77	0.79	−0.8	4	7,405	se.	50	nw.	2	20	4	4	2.5	0.0	....
Miami	25	71	79	30.14	30.17	.....	64.8	−4.0	81	15	73	27	3	56	33	59	55	74	0.45	−2.2	4	5,634	se.	38	nw.	2	18	9	1	2.7	0.0	....
Sand Key	23	39	72	30.10	30.14	+ .07	68.8	.....	78	21	72	45	3	65	19	64	62	80	0.51	.....	4	10,117	se.	60	n.	2	19	6	3	2.6	0.0	....
Tampa	35	79	96	30.14	30.18	+ .08	61.7	+0.8	83	28	72	26	3	52	32	54	50	75	1.56	−1.7	5	4,838	sw.	35	nw.	2	13	12	3	3.7	0.0	....
East Gulf States.							**51.0**	**+0.2**										**71**	**4.93**	**+0.2**									**4.9**			
Atlanta	1,174	190	216	28.86	30.13	+0.01	44.4	−0.8	76	28	54	2	3	34	45	39	32	66	5.81	+1.2	11	9,751	nw.	63	nw.	4	10	7	11	5.3	T.	....
Macon	370	78	87	29.73	30.14	+ .02	48.8	−0.1	79	27	60	8	3	38	40	43	36	67	3.23	−1.4	11	5,469	s.	42	nw.	4	14	6	8	4.4	0.2	....
Thomasville	273	49	58	29.85	30.16	+ .04	53.2	−1.8	80	27	64	13	3	42	35	45	41	69	3.74	−0.7	9	3,903	sw.	29	nw.	2	10	4	14	5.5	0.0	....
Pensacola	56	149	185	30.10	30.16	+ .05	54.0	−1.5	74	20	61	17	3	47	38	51	48	81	3.08	−1.4	9	9,937	s.	48	n.	4	10	10	8	5.0	0.0	....
Anniston	741	9	57	29.34	30.15	+ .03	46.4	+0.6	81	28	58	6	3	35	47	....	....	....	7.10	+2.4	11	5,138	nw.	36	nw.	4	12	8	8	4.7	0.1	....
Birmingham	700	11	48	29.38	30.16	+ .04	47.8	−0.5	80	28	58	7	3	37	44	40	33	65	5.89	+1.1	11	6,093	s.	36	nw.	4	12	5	11	5.1	T.	....
Mobile	57	125	161	30.10	30.16	+ .05	54.4	+1.2	78	20	63	19	3	46	42	50	45	77	4.95	−0.4	13	7,717	s.	44	nw.	1	13	7	8	4.6	0.0	....
Montgomery	223	100	112	29.91	30.17	+ .05	50.6	−0.7	81	28	61	10	3	40	43	44	38	66	4.86	−0.7	10	5,776	s.	42	nw.	4	13	4	11	4.8	T.	....
Corinth	469	6	....	.....	.....	.....	41.4	.....	82	26	53	8	3	30	42	....	....	....	3.42	.....	10	.....	s.	.....	.....	.....	8	14	6	....	T.	....
Jackson	304	5	....	.....	.....	.....	53.2	.....	83	26	65	15	3	42	45	....	....	....	7.34	.....	13	.....	s.	.....	.....	.....	12	9	7	....	0.0	....
Meridian	375	85	93	29.74	30.15	+ .04	51.0	+1.9	81	28	62	13	3	40	46	44	38	67	5.89	+1.0	10	4,938	sw.	30	nw.	4	13	7	8	4.6	0.0	....
Vicksburg	247	65	74	29.88	30.17	+ .07	51.8	+0.9	81	26	62	17	2	42	41	45	39	68	6.49	+1.9	9	5,840	se.	29	nw.	4	12	5	11	4.8	0.0	....
New Orleans	51	76	84	30.09	30.15	+ .06	58.8	+2.5	83	20	68	26	3	50	42	54	50	81	3.19	−1.3	11	5,326	sw.	31	n.	1	9	10	9	5.1	0.0	....
West Gulf States.							**51.6**	**+2.2**										**67**	**1.27**	**−1.4**									**4.6**			
Shreveport	219	77	93	29.86	30.14	+0.05	51.6	+1.6	84	26	63	16	2	40	43	44	37	65	2.10	−1.5	8	5,829	s.	30	nw.	4	14	7	7	4.2	0.0	....
Bentonville	1,303	11	44	28.68	30.09	− .01	36.6	−1.9	76	26	49	−4	1	24	39	....	....	....	0.93	−1.6	4	4,987	s.	26	nw.	4	17	6	5	3.5	8.1	....
Fort Smith	457	79	94	29.62	30.11	+ .01	42.1	+0.3	83	26	54	6	2	31	37	35	27	60	0.73	−2.0	3	6,494	e.	38	nw.	4	15	6	7	3.9	T.	....
Little Rock	357	139	147	29.75	30.14	+ .03	44.8	+0.7	82	26	56	11	2	34	35	38	30	61	1.72	−2.5	6	7,818	nw.	52	nw.	4	8	11	9	5.0	T.	....
Brownsville	57	4	26	.....	.....	.....	66.3	.....	92	19	78	24	2	55	40	....	....	....	0.20	.....	3	.....	s.	.....	.....	.....	....	....	....	....	....	....
Corpus Christi	20	69	77	30.10	30.12	+ .07	60.8	+3.1	88	23	69	26	2	52	32	55	52	81	T.	−2.0	0	8,625	se.	46	se.	27	5	13	10	6.0	0.0	....
Dallas	512	109	117	29.57	30.13	.....	49.3	.....	90	25	61	13	2	38	39	....	....	....	1.31	.....	7	6,828	s.	39	s.	3	13	5	10	4.8	0.0	....
Fort Worth	670	106	114	29.38	30.11	+ .04	49.9	+1.8	93	25	62	12	1	38	40	40	29	52	1.47	+0.2	6	7,204	nw.	38	n.	4	14	3	11	4.8	0.0	....
Galveston	54	106	114	30.08	30.14	+ .07	57.2	+1.6	73	26	64	26	2	51	37	54	52	87	2.51	−0.6	8	7,965	s.	44	n.	1	11	7	10	5.1	0.0	....
Houston	138	111	121	29.98	30.14	.....	59.4	+5.4	85	24	70	21	2	49	33	....	....	....	1.56	.....	7	6,137	s.	29	n.	1	10	11	7	4.8	0.0	....
Palestine	510	64	72	29.58	30.12	+ .04	53.4	+2.5	86	26	64	14	2	42	41	46	10	71	1.95	−1.4	6	5,898	s.	38	n.	4	14	3	11	4.8	0.0	....
San Antonio	701	119	132	29.37	30.10	+ .05	57.6	+3.2	91	25	70	19	2	45	38	47	37	57	0.49	−1.3	5	5,286	ne.	37	ne.	1	17	5	6	3.5	0.0	....
Taylor	582	55	63	29.53	30.15	+ .09	53.8	+2.5	89	21	67	14	2	41	48	....	....	....	0.78	−1.8	6	7,047	n.	39	ne.	4	13	8	7	4.4	0.0	....

TABLE I.—*Climatological data for Weather Bureau stations, February, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean minimum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	°*F.*			%	*In.*	*In.*		*Miles.*							*0–10*	*In.*	*In.*
Ohio Valley and Tennessee.							**32.4**	**−3.2**													**71**	**2.17**	**−1.4**									**6.3**		
Chattanooga	762	189	213	29.31	30.15	+0.02	42.0	−1.7	74	26	52	4	3	32	43	37	30	66	4.30	−0.6	12	6,731	sw.	52	nw.	4	10	8	10	5.6	1.7	....
Knoxville	996	93	100	29.03	30.11	− .01	39.4	−1.4	72	26	50	2	3	28	40	34	27	66	3.53	−1.4	12	4,594	sw.	36	nw.	4	8	7	13	6.4	0.2	....
Memphis	399	76	97	29.73	30.17	+ .06	43.2	−0.1	80	26	53	8	2	24	33	37	29	62	1.97	−2.4	7	7,611	sw.	60	nw.	4	13	8	7	4.5	T.	....
Nashville	546	168	191	29.54	30.15	+ .03	39.8	−1.3	79	26	50	1	2	29	38	34	28	68	2.76	−1.6	11	8,144	nw.	58	nw.	4	8	10	10	5.8	0.5	....
Lexington	989	193	230	29.00	30.11	.00	31.8	−3.8	71	26	42	−7	5	22	40	....	....	....	2.12	−1.1	11	11,447	sw.	60	sw.	4	7	8	13	6.4	7.4	1.0
Louisville	525	219	255	29.53	30.13	+ .02	32.2	−4.4	73	26	42	−4	5	22	40	28	21	68	2.55	−1.2	7	10,931	n.	60	w.	4	8	7	13	6.1	12.1	4.2
Evansville	431	139	175	29.64	30.12	+ .01	32.5	−3.3	72	26	42	−5	2	23	37	28	23	69	1.13	−1.9	8	9,694	nw.	46	w.	4	4	15	9	6.0	7.8	3.0
Indianapolis	822	194	230	29.17	30.09	− .01	25.1	−5.6	68	26	35	−9	2	15	38	22	18	73	1.15	−1.9	6	10,024	w.	49	nw.	4	3	11	14	6.9	3.7	....
Terre Haute	575	96	129	29.46	30.10	.....	26.4	.....	68	26	36	−10	2	17	36	24	18	72	0.76	.....	5	8,299	nw.	42	nw.	4	1	16	11	7.4	1.0	....
Cincinnati	628	11	51	29.39	30.09	− .01	29.0	−3.4	70	26	39	−9	5	19	39	25	20	76	1.50	−1.7	8	7,520	sw.	38	w.	4	2	10	16	7.1	5.8	1.0
Columbus	824	173	222	29.16	30.07	− .02	25.8	−5.2	66	26	35	−8	5	16	35	23	18	74	1.09	−2.0	7	9,226	nw.	56	w.	4	7	10	11	5.4	4.0	....
Dayton	899	181	216	29.06	30.06	.....	26.0	−4.0	66	26	35	−9	5	17	33	23	20	80	1.05	−2.0	7	9,069	sw.	48	nw.	4	4	11	13	6.7	3.2	....
Pittsburgh	842	353	410	29.10	30.04	− .05	27.0	−4.8	64	26	36	−6	5	18	45	23	18	72	0.99	−1.7	10	9,561	nw.	43	nw	22	5	12	11	6.4	3.4	T.
Elkins	1,940	41	50	27.92	30.08	− .02	28.9	−2.6	72	27	41	−10	5	17	48	25	20	76	3.79	+0.6	14	4,127	w.	30	w.	4	3	8	17	7.8	14.1	5.1
Parkersburg	638	77	84	29.41	30.09	− .01	30.8	−3.1	72	26	41	− 6	5	20	41	26	22	75	2.44	−0.8	10	5,621	sw.	43	nw.	4	6	11	11	5.9	12.1	2.8
Lower Lake Region.							**19.0**	**−5.7**													**80**	**1.39**	**−1.1**									**6.9**		
Buffalo	767	247	280	29.10	29.96	−0.10	18.0	−6.0	51	26	26	− 8	12	10	38	16	13	82	1.97	−0.9	19	15,505	w.	74	sw.	3	6	8	14	6.8	18.3	2.5
Canton	448	10	61	29.41	29.92	.....	9.5	−8.5	43	17	20	−32	12	−1	39	....	....	....	1.63	−0.9	16	8,606	w.	45	sw.	23	12	4	12	5.5	15.0	8.1
Oswego	335	76	91	29.56	29.95	− .11	18.4	−5.5	47	26	27	−10	12	10	31	17	15	86	1.52	−1.0	21	9,505	nw.	41	sw.	3	0	6	22	8.7	39.6	12.0
Rochester	523	97	113	29.37	29.97	− .09	18.8	−5.1	50	26	26	− 8	13	11	28	17	13	77	1.67	−1.2	17	8,296	sw.	40	w.	3	4	7	17	7.4	16.7	1.5
Syracuse	597	97	113	29.28	29.96	− .11	18.9	−4.9	50	26	28	− 6	3	10	32	17	14	83	2.73	+0.9	20	10,483	w.	52	s.	23	2	11	15	7.4	22.8	2.5
Erie	714	130	166	29.19	30.00	− .07	20.1	−6.0	56	26	28	−10	12	12	34	18	15	82	0.92	−1.9	12	11,348	sw.	52	s.	26	1	14	13	7.1	7.9	....
Cleveland	762	190	201	29.18	30.03	− .04	21.3	−5.5	59	26	30	− 8	12	13	33	19	14	72	1.22	−1.4	14	10,928	nw.	46	s.	23	3	7	18	7.8	9.9	....
Sandusky	629	62	103	29.32	30.03	− .04	21.6	−5.5	58	26	30	−10	12	13	32	19	16	80	0.73	−1.7	9	10,365	sw.	44	nw.	2	2	9	17	7.1	6.6	....
Toledo	628	208	243	29.34	30.05	− .02	21.7	−5.1	58	26	30	−10	12	13	30	19	15	77	0.63	−1.3	10	10,939	sw.	41	sw.	16	8	11	9	5.9	4.3	....
Fort Wayne	856	113	124	29.11	30.08	.....	20.8	−5.0	58	26	30	− 9	12	12	33	18	14	76	0.52	.....	5	8,394	sw.	40	w.	4	5	11	12	6.5	2.8	....
Detroit	730	218	245	29.19	30.02	− .04	19.5	−5.5	50	26	27	−12	12	12	25	17	13	80	0.91	−1.3	10	9,233	nw.	39	w.	7	7	11	10	5.7	5.5	T.
Upper Lake Region.							**10.5**	**−8.7**													**83**	**0.89**	**−0.9**									**5.9**		
Alpena	609	13	92	29.28	29.98	−0.05	9.5	−8.3	44	17	19	−18	12	0	36	8	5	86	0.73	−1.1	9	9,159	nw.	45	w.	17	11	10	7	4.6	11.7	6.5
Escanaba	612	54	60	29.31	30.02	− .04	6.2	−9.1	39	17	16	−20	12	−3	39	5	3	87	0.87	−0.5	5	6,013	nw.	37	nw.	17	13	7	8	4.6	10.1	14.5
Grand Haven	632	54	92	29.31	30.04	− .01	16.9	−7.3	44	25	24	−16	12	9	32	15	12	79	1.54	−0.4	17	9,334	w.	39	w.	3	3	12	13	6.8	15.4	1.2
Grand Rapids	707	70	87	29.23	30.04	− .01	17.4	−8.1	45	26	25	−12	12	10	32	15	11	77	0.67	−1.2	15	5,292	nw.	26	nw.	17	5	11	12	6.3	8.4	1.2
Houghton	684	62	99	29.24	30.01	− .04	3.2	−12.8	40	17	12	−22	21	−6	50	....	....	....	1.28	−0.4	12	9,332	w.	48	w.	4	7	9	12	6.4	13.5	20.0
Lansing	878	11	62	29.03	30.02	.....	15.5	−6.1	45	25	25	−21	12	6	35	13	10	83	0.62	−1.4	14	5,287	nw.	24	nw.	2	3	12	13	6.9	5.5	T.
Ludington	637	60	66	29.29	30.02	.....	14.8	.....	42	25	22	−18	12	7	33	13	12	90	1.27	.....	16	8,288	nw.	40	sw.	17	1	10	17	7.6	16.3	6.8
Marquette	734	77	111	29.18	30.03	− .02	6.4	−9.5	40	17	15	−18	11	−2	41	5	2	84	1.59	−0.1	16	7,279	nw.	42	s.	17	3	9	16	7.1	17.4	23.2
Port Huron	638	70	120	29.28	30.00	− .05	15.8	−7.2	46	23	24	−17	12	7	29	14	12	87	0.61	−1.5	11	8,755	nw.	35	nw.	22	5	16	7	5.6	7.9	0.5
Saginaw	641	48	82	29.28	30.01	.....	14.3	.....	44	17	23	−19	12	5	34	13	11	90	0.46	−1.6	10	7,511	w.	34	nw.	21	2	11	15	7.3	3.7	1.2
Sault Sainte Marie	614	11	61	29.25	29.99	− .04	3.2	−10.2	39	17	13	−27	12	−7	39	2	0	85	1.51	+0.1	15	7,758	w.	49	nw.	17	10	10	8	5.3	18.3	21.0
Chicago	823	140	310	29.15	30.08	.00	19.8	−5.6	50	25	28	−10	2	11	30	17	12	69	0.67	−1.5	8	9,498	nw.	40	nw.	4	10	10	8	5.1	4.5	....
Green Bay	617	109	144	29.33	30.04	− .02	8.1	−9.1	41	17	17	−18	2	−1	36	6	1	72	0.50	−1.1	6	8,374	sw.	46	sw.	16	9	10	9	5.7	6.8	15.0
Milwaukee	681	119	133	29.28	30.06	.00	14.0	−7.9	44	26	23	−15	2	5	34	13	10	86	0.56	−1.3	7	7,942	w.	34	se.	19	12	9	7	4.5	4.9	0.5
Duluth	1,133	11	47	28.77	30.08	.00	1.8	−11.8	36	17	12	−25	2	−8	46	−1	− 3	87	0.81	−0.2	9	9,392	w.	57	w.	17	13	6	9	4.8	10.7	12.3
North Dakota.							**−0.6**	**−7.6**													**86**	**0.66**	**+0.1**									**5.8**		
Moorhead	940	8	57	29.11	30.20	+0.09	−0.4	−7.4	39	16	10	−32	2	−10	38	−1	−5	79	0.85	+0.1	11	6,756	nw.	40	nw.	16	12	9	7	4.5	7.8	13.8
Bismarck	1,674	8	57	28.32	30.24	+ .12	1.8	−6.5	46	16	11	−39	2	−8	42	2	0	89	0.44	−0.1	10	8,018	nw.	54	nw.	16	7	6	15	6.6	6.9	14.3
Devils Lake	1,482	11	44	28.46	30.16	+ .05	−3.8	−8.3	40	16	6	−40	2	−13	46	−4	−7	88	0.68	+0.2	10	7,993	nw.	60	n.	16	6	10	12	6.5	9.1	10.1
Grand Forks	835	12	89	.....	.....	.....	−4.6	.....	37	16	6	−35	2	−15	46	−5	.....	....	1.12	.....	7	.....	nw.	54	n.	17	7	10	1	.....	10.8	19.5
Williston	1,872	41	48	28.09	30.21	+ .10	−0.2	−8.1	42	16	9	−40	2	−9	42	−1	−3	87	0.67	+0.2	8	6,280	w.	48	nw.	16	9	12	7	5.5	5.6	4.2
Upper Mississippi Valley.							**18.1**	**−5.5**													**75**	**0.48**	**−1.7**									**5.4**		
Minneapolis	918	10	208	29.06	30.10	.....	5.6	.....	42	16	15	−25	2	−4	43	....	....	....	0.43	−0.3	10	8,697	w.	43	w.	17	11	6	11	5.2	7.7	17.2
St. Paul	837	201	236	29.17	30.13	+0.04	6.2	−8.8	42	16	16	−25	2	−4	44	....	....	....	0.44	−0.4	9	9,719	nw.	52	nw.	17	11	10	7	4.8	5.9	18.5
La Crosse	714	11	48	29.30	30.12	+ .01	9.9	−8.5	45	17	21	−22	2	−1	39	....	....	....	0.59	−0.5	3	4,182	nw.	29	nw.	4	9	8	11	5.8	8.1	12.7
Madison	974	70	78	28.99	30.11	+ .04	11.1	−8.5	42	17	21	−21	2	1	35	9	4	75	0.64	−0.8	4	7,099	nw.	33	nw.	4	8	6	14	5.9	6.6	2.7
Wausau	1,247	4	....	28.63	30.05	.....	4.6	.....	39	17	15	−27	12	−6	43	....	....	....	1.10	.....	7	.....	nw.	....	....	12	6	10	4.8	14.1	18.9
Charles City	1,015	10	49	29.00	30.14	+ .04	9.2	−5.9	43	16	21	−26	2	−2	37	6	5	87	0.82	−0.2	3	5,705	nw.	28	nw.	4	8	13	7	5.0	9.6	2.5
Davenport	606	71	79	29.44	30.14	+ .04	18.1	−5.7	52	25	28	−19	2	8	33	15	12	78	0.22	−1.3	5	6,344	nw.	36	nw.	4	5	14	9	6.0	1.8	....
Des Moines	861	84	97	29.19	30.15	+ .04	19.2	−4.9	62	25	30	−22	2	8	40	16	11	72	0.52	−0.6	5	6,350	nw.	39	nw.	4	10	7	11	5.6	4.1	....
Dubuque	698	81	96	29.35	30.15	+ .06	14.2	−7.4	47	25	25	−20	2	4	33	12	8	78	0.17	−1.2	4	5,524	nw.	35	nw.	4	11	6	11	5.3	1.7	1.1
Keokuk	614	64	78	29.44	30.15	+ .04	22.6	−4.0	62	25	34	−18	2	12	38	19	12	66	0.13	−1.5	4	6,392	nw.	34	w.	4	16	7	5	3.9	1.0	....
Cairo	356	87	93	29.73	30.12	.00	35.6	−2.0	75	26	46	− 4	2	25	35	31	25	70	1.54	−1.8	6	8,683	n.	42	nw.	4	7	9	12	6.0	1.1	....
Peoria	609	11	45	29.44	30.13	+ .03	20.8	−5.1	53	25	31	−16	2	11	31	18	15	81	0.27	−2.4	5	6,274	nw.	34	nw.	4	10	7	11	5.4	1.2	....
Springfield, Ill	644	10	91	29.40	30.11	+ .01	24.6	−4.5	57	25	34	−14	2	15	32	21	16	71	0.47	−2.3	5	7,305	nw.	39	nw.	4	8	8	12	5.9	1.3	....
Hannibal	534	74	109	29.53	30.13	+ .02	25.6	−3.5	66	25	37	−16	2	14	38	....	....	....	0.10	−1.5	4	7,446	nw.	38	nw.	4	11	11	6	4.8	0.9	....
St. Louis	567	265	303	29.49	30.12	+ .01	30.4	−3.1	....	....	....	−10	2	20	39	26	21	69	0.35	−2.4	4	10,023	nw.	52	nw.	4	7	10	11	6.2	1.0	....
Missouri Valley.							**21.9**	**−2.5**	68	25	41										**72**	**0.27**	**−0.8**									**4.8**		
Columbia, Mo.	781	11	84	29.25	30.12	+0.01	28.3	−1.8	68	25	39	−13	2	17	39	....	....	....	0.25	−1.9	2	7,317	sw.	45	nw.	4	11	9	8	4.8	0.3	....
Kansas City	963	161	181	29.07	30.14	+ .03	29.4	−0.5	73	22	41	−12	2	18	46	24	16	59	0.07	−1.5	3	9,853	n.	53	nw.	4	16	11	1	3.2	0.8	....
St. Joseph	967	11	49	29.07	30.15	.....	27.0	.....	70	22	39	−16	2	15	46	21	13	62	0.02	.....	1	7,314	nw.	42	nw.	4	11	15	2	4.1	0.2	....
Springfield, Mo.	1,324	98	104	28.68	30.12	+ .01	33.0	−0.6	70	25	44	−10	2	22	38	28	20	63	0.47	−1.8	3	8,841	nw.	44	nw.	4	16	6	6	3.8	4.0	....
Iola	984	11	50	29.04	30.13	+ .03	31.8	−0.2	72	22	44	− 9	2	19	40	....	....	....	0.07	−1.0	2	6,235	n.	37	n.	4	12	13	3	3.5	0.7	....
Topeka	987	85	101	.....	.....	.....	29.8	−0.2	74	22	42	−12	2	17	46	....	....	....	T.	−1.4	0	7,841	nw.	49	nw.	4	10	16	2	4.0	T.	....
Drexel	1,299	10	54	28.71	30.17	.....	19.7	.....	66	25	31	−23	2	9	41	15	11	79	0.13	.....	2	8,219	nw.	45	nw.	4	9	12	7	5.2	1.5	....
Lincoln	1,189	11	84	28.84	30.16	+ .06	24.3	−0.5	72	25	36	−20	1	13	42	19	11	62	0.02	−0.7	1	8,318	n.	50	nw.	4	7	16	5	4.8	0.4	....
Omaha	1,105	115	122	28.94	30.18	+ .07	21.6	−2.1	68	25	32	−23	2	11	41	17	10	65	0.20	−0.6	2	7,444	nw.	46	nw.	4	11	14	3	4.4	2.0	....
Valentine	2,598	47	54	27.32	30.18	+ .09	18.0	−3.2	52	16	31	−32	2	5	49	15	12	85	0.37	−0.2	8	6,762	nw.	45	nw.	4	5	14	9	6.0	5.0	T.
Sioux City	1,135	94	164	28.89	30.18	+ .06	15.0	−4.8	53	16	24	−28	2	6	33	12	8	76	0.57	0.0	5	9,956	nw.	69	nw.	4	10	9	9	5.5	5.8	0.5
Huron	1,306	59	74	28.74	30.23	+ .11	7.6	−5.3	44	16	18	−35	2	−2	36	6	3	83	0.44	0.0	7	8,923	nw.	52	nw.	4	9	9	10	5.5	5.5	2.6
Pierre	1,572	70	75	28.45	30.23	+ .12	10.4	−6.5	48	16	20	−32	2	0	46	8	5	83	0.37	−0.1	11	6,951	nw.	55	nw.	4	7	8	13	5.8	4.5	T.
Yankton	1,233	49	57	28.81	30.21	+ .09	14.0	−4.2	54	16	24	−29	2	4	34	....	....	....	0.39	−0.2	5	6,818	nw.	40	nw.	4	8	11	9	5.9	4.4	T.

TABLE I.—*Climatological data for Weather Bureau stations, February, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.										Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	° *F.*	° *F.*	° *F*		° *F*	° *F.*		° *F*	° *F.*		° *F.*	° *F.*	%	*In.*	*In.*		*Miles.*								*0–10*	*In.*	*In.*
Northern Slope.							**19.4**	**−2.1**											**73**	**1.04**	**+0.2**									**6.5**		
Billings	3,140	5	....	....	....	....	19.5	.....	54	8	30	−32	1	8	44		....	....	....	0.48	.....	....	....	....	....	....	6	12	6	....	6.7	6.5
Havre	2,505	11	44	27.42	30.22	+0.15	6.8	−8.2	44	16	16	−27	26	−2	38	6	4	88	0.90	+0.4	9	5,213	ne.	39	nw.	16	8	8	12	6.2	9.0	8.3
Helena	4,110	87	114	25.78	30.15	+ .06	17.6	−4.6	49	16	27	−19	1	8	46	16	12	77	1.66	+0.9	13	4,588	sw.	40	w.	15	4	8	16	7.2	20.8	15.0
Kalispell	2,962	11	34	26.93	30.11	+ .03	22.0	−1.8	46	3	30	− 4	18	14	26	20	18	84	1.82	+0.4	15	2,425	w.	34	nw.	16	2	12	14	7.0	18.2	12.1
Miles City	2,371	48	55	27.55	30.25	+ .16	11.2	−5.6	46	16	22	−38	1	0	42	8	5	80	0.75	+0.2	11	4,035	ne.	45	nw.	16	9	11	8	6.0	8.0	7.1
Rapid City	3,259	50	58	26.60	30.20	+ .12	19.8	−3.7	56	16	32	−25	1	7	58	15	8	65	0.33	−0.1	8	6,478	n.	48	n.	3	3	11	14	7.0	3.4	T.
Cheyenne	6,088	84	101	23.91	30.06	+ .03	27.2	+0.9	54	25	37	− 4	1	18	31	22	14	60	0.80	+0.2	7	12,743	w.	61	w.	16	5	14	9	5.6	12.6	0.4
Lander	5,372	60	68	24.57	30.10	+ .02	23.6	+1.8	49	24	36	−16	1	11	40	19	12	62	0.89	+0.2	7	3,484	sw.	64	sw.	24	6	15	7	5.7	9.1	T.
Sheridan	3,790	10	47	26.08	30.15	.....	20.5	.....	52	16	34	−30	1	8	56	16	13	78	0.37	.....	11	3,790	nw.	46	sw.	21	1	7	20	7.9	5.1	0.3
Yellowstone Park	6,200	11	48	23.78	30.12	+ .02	19.5	−0.1	41	25	29	− 6	28	10	31	17	12	72	1.83	0.0	11	5,827	s.	42	sw.	25	6	11	11	6.5	15.6	23.0
North Platte	2,821	11	51	27.11	30.16	+ .09	26.8	+2.2	73	25	40	−18	1	14	49	21	15	67	0.35	0.0	5	5,329	w.	36	n.	4	7	12	9	5.8	4.0	0.8
Middle Slope.							**33.8**	**+1.4**											**59**	**0.32**	**−0.4**									**4.3**		
Denver	5,292	106	113	24.67	30.04	+0.03	34.6	+3.5	65	25	45	0	1	24	39	28	18	56	0.46	0.0	7	5,565	se.	35	w.	4	5	16	7	5.5	6.0	0.3
Pueblo	4,685	80	86	25.25	30.03	+ .03	35.4	+3.6	70	25	49	− 7	1	22	47	28	19	56	0.49	0.0	5	5,525	w.	46	nw.	25	14	10	4	3.6	5.4	1.2
Concordia	1,392	50	58	28.63	30.16	+ .07	28.6	−0.2	75	25	41	−15	1	16	47	23	18	74	0.07	−0.7	1	6,239	nw.	37	nw.	4	6	17	5	5.4	0.7	....
Dodge	2,509	11	51	27.44	30.13	+ .07	32.1	+1.0	79	25	47	−10	2	17	46	26	18	60	0.04	−0.7	1	7,400	n.	37	n.	4	14	12	2	3.8	0.0	....
Wichita	1,358	139	158	28.63	30.12	+ .04	32.8	−0.2	74	22	45	− 8	2	21	42	20	16	54	T.	−1.1	0	9,855	ne.	46	n.	4	14	9	5	4.1	T.	....
Altus	1,410	5	....	....	....	....	42.8	.....	93	25	58	− 6	1	28	57	....	....	....	0.50	.....	1	.....	n.	....	....	....	25	1	2	....	0.0	....
Muskogee	652	4	....	....	....	....	37.2	.....	76	25	50	− 1	1	25	50	....	....	....	0.56	.....	2	.....	s.	....	....	....	19	3	6	....	0.0	....
Oklahoma	1,214	10	47	28.80	30.12	+ .05	39.1	+0.6	84	25	52	0	1	27	39	30	20	54	0.84	−0.1	1	10,061	n.	54	n.	4	15	9	4	3.4	6.4	....
Southern Slope.							**47.6**	**+3.0**											**45**	**0.40**	**−0.5**									**3.6**		
Abilene	1,738	10	52	28.26	30.10	+0.05	49.8	+5.0	91	25	63	12	1	36	42	37	21	41	1.00	−0.1	3	7,304	s.	41	n.	4	13	7	8	4.5	0.0	....
Amarillo	3,676	10	49	26.28	30.08	+ .06	40.6	+3.4	83	25	54	4	1	27	46	31	22	56	0.22	−0.7	1	8,532	sw.	42	sw.	16	20	8	0	3.2	2.2	....
Del Rio	944	64	71	29.10	30.11	+ .11	55.9	+2.3	91	25	70	18	2	42	47	....	....	....	0.11	−0.8	2	5,924	e.	37	nw.	1	18	5	5	3.3	0.0	....
Roswell	3,566	75	85	26.40	30.06	+ .08	44.0	+1.5	83	25	60	9	1	28	49	33	16	37	0.26	−0.3	3	5,532	sw.	42	sw.	18	15	13	0	3.4	1.5	....
Southern Plateau.							**43.5**	**−1.3**											**52**	**0.35**	**−0.3**									**3.1**		
El Paso	3,762	110	133	26.24	30.05	+0.10	48.8	−0.1	79	25	62	21	2	35	40	37	19	36	T.	−0.5	0	7,587	nw.	63	w.	18	13	14	1	3.2	0.0	....
Santa Fe	7,013	57	66	23.21	30.06	+ .08	32.8	+0.8	57	25	43	6	2	23	27	26	18	58	0.23	−0.6	4	5,450	sw.	38	sw.	18	9	16	3	4.3	4.5	....
Flagstaff	6,908	8	57	23.34	30.08	+ .08	26.1	−4.7	48	10	38	− 9	1	14	41	23	.....	....	1.30	.....	5	.....	w.	41	w.	19	14	9	5	....	21.8	1.0
Phoenix	1,108	76	81	28.91	30.08	+ .09	53.8	−0.6	76	24	68	31	2	40	39	45	36	58	0.95	+0.3	4	3,250	e.	24	ne.	7	19	5	4	3.1	0.0	....
Yuma	141	9	54	29.94	30.09	+ .09	58.8	−0.4	80	25	72	36	18	46	33	46	31	40	0.06	−0.5	1	4,438	n.	27	n.	2	25	2	1	1.2	0.0	....
Independence	3,910	11	42	26.00	30.04	− .02	40.8	−2.9	66	5	56	18	2	26	44	34	28	69	0.51	−0.3	5	.....	w.	....	....	....	12	10	6	3.6	0.0	....
Middle Plateau.							**28.7**	**−4.3**											**70**	**0.80**	**−0.3**									**5.0**		
Reno	4,532	74	81	25.49	30.14	+0.06	33.6	−2.0	54	15	44	1	18	23	38	29	23	68	2.01	+0.2	8	4,967	w.	57	w.	20	10	7	11	5.2	8.0	....
Tonopah	6,090	12	20	24.06	30.12	.....	32.2	.....	49	24	40	9	1	24	21	27	21	64	0.42	−0.4	3	6,681	se.	45	se.	24	17	8	3	3.6	3.9	....
Winnemucca	4,344	18	56	25.66	30.16	+ .07	28.9	−4.4	56	24	39	−12	1	19	35	25	21	73	0.20	−0.7	7	6,336	sw.	52	sw.	25	10	3	15	6.0	1.6	....
Modena	5,479	10	43	24.64	30.14	+ .10	26.2	−5.4	49	25	37	− 7	1	16	36	23	19	76	0.83	−0.4	5	7,581	sw.	51	sw.	25	11	11	6	4.0	9.5	T.
Salt Lake City	4,260	147	189	25.67	30.16	+ .08	28.6	−4.3	55	25	36	2	1	21	22	26	21	71	1.22	−0.2	10	5,626	nw.	42	nw.	25	5	7	16	7.0	13.2	....
Grand Junction	4,602	82	96	25.44	30.13	+ .09	26.0	−5.5	60	25	38	−15	2	14	34	22	17	71	0.10	−0.5	4	3,627	nw.	31	sw.	25	14	7	7	4.5	1.7	....
Northern Plateau.							**30.5**	**−1.6**											**77**	**1.28**	**−0.1**									**7.8**		
Baker	3,471	48	53	26.48	30.18	+0.06	23.8	−4.1	41	24	32	− 1	28	16	27	22	19	80	1.06	−0.3	9	4,313	se.	26	s.	24	4	14	10	6.0	8.6	1.5
Boise	2,739	78	86	27.26	30.21	+ .09	30.5	−3.3	52	25	38	10	1	23	23	27	22	71	1.21	−0.2	10	3,583	se.	38	se.	21	2	10	16	7.6	8.5	....
Lewiston	757	40	48	29.30	30.13	+ .02	37.0	+0.8	56	16	43	20	26	30	24	....	....	....	0.95	−0.4	14	2,619	e.	34	w.	16	2	3	23	8.6	7.7	1.6
Pocatello	4,477	60	68	25.50	30.17	+ .07	24.9	−3.2	47	25	33	0	1	17	26	23	20	80	2.15	+1.3	13	6,726	se.	44	s.	21	3	8	17	7.5	18.5	T.
Spokane	1,929	101	110	28.02	30.13	+ .04	29.8	−0.3	49	4	35	3	27	24	28	28	26	81	1.28	−0.6	12	3,337	sw.	29	sw.	16	1	4	23	8.8	11.9	4.4
Walla Walla	991	57	65	29.04	30.14	+ .05	36.9	+0.5	59	5	43	14	1	31	23	34	30	75	1.12	−0.5	11	3,143	s.	28	sw.	20	1	6	21	8.2	8.4	3.5
North Pacific Coast Region.							**40.3**	**−1.0**											**75**	**3.86**	**−1.4**									**8.1**		
North Head	211	11	56	29.84	30.08	+0.02	40.5	−1.6	55	7	44	30	23	37	17	40	39	94	4.22	−1.6	18	9,084	se.	60	nw.	16	6	3	19	7.6	6.8	0.5
North Yakima	1,071	4	....	....	....	.....	34.2	.....	63	5	42	12	1	26	33	....	....	....	0.47	.....	3	.....	nw.	....	....	....	6	3	19	....	3.8	T.
Port Angeles	42	8	48	30.07	30.10	.....	37.2	.....	50	3	42	19	24	33	19	....	....	....	2.46	−0.6	13	3,371	se.	37	sw.	15	2	2	24	8.8	18.9	4.0
Seattle	125	215	250	29.98	30.11	+ .05	39.3	−1.2	52	4	43	26	24	36	16	38	36	87	1.43	−2.4	13	5,190	se.	48	s.	15	0	2	26	9.3	5.0	....
Tacoma	213	113	120	29.87	30.10	+ .04	39.6	−0.8	55	3	43	29	24	36	14	39	38	92	2.17	−3.0	14	2,700	sw.	24	sw.	15	0	4	24	8.9	12.0	....
Tatoosh Island	109	7	57	29.95	30.05	+ .05	39.8	−1.2	50	4	43	31	24	37	10	39	38	92	8.54	−0.2	17	11,147	e.	62	w.	15	6	5	17	7.2	5.3	T.
Medford	1,425	4	....	....	....	.....	38.0	.....	60	12	47	16	1	29	36	....	....	....	3.37	.....	13	.....	w.	....	....	....	6	3	19	....	17.5	6.0
Portland, Oreg	153	68	106	29.94	30.10	+ .02	41.5	+0.2	61	3	46	30	23	37	20	39	35	78	3.32	−2.4	15	3,779	nw.	30	sw.	2	3	5	20	8.1	13.3	....
Roseburg	510	9	57	29.57	30.13	+ .03	41.2	−1.4	63	10	49	22	1	34	33	39	36	82	4.90	+0.3	15	1,542	s.	23	sw.	22	1	18	9	6.8	17.8	T.
Middle Pacific Coast Region.							**48.7**	**−0.3**											**71**	**4.66**	**+0.4**									**5.1**		
Eureka	62	73	89	30.06	30.13	+0.02	44.2	−2.6	60	6	50	30	1	38	23	42	40	85	5.10	−1.9	13	4,832	se.	44	n.	16	6	5	17	7.0	0.0	....
Mount Tamalpais	2,375	11	18	27.60	30.10	.00	45.6	0.0	61	15	51	17	30	40	27	40	33	67	5.40	−0.3	11	14,882	n.	73	w.	25	9	8	11	5.5	0.8	....
Point Reyes Light	490	7	18	29.54	30.06	.....	48.5	−0.7	72	15	54	38	25	43	25	....	....	....	2.46	.....	12	14,821	nw.	101	nw.	16	7	9	12	5.8	0.0	....
Red Bluff	332	50	56	29.71	30.08	− .03	50.4	+1.1	75	15	60	29	1	41	35	43	32	55	3.79	+0.2	8	5,810	nw.	28	se.	24	13	6	9	4.1	0.0	....
Sacramento	69	106	117	30.03	30.10	+ .01	50.0	−0.2	73	14	60	28	1	40	31	46	41	73	4.97	+1.8	9	6,740	se.	49	s.	25	15	4	9	4.1	0.0	....
San Francisco	155	209	213	29.93	30.10	.00	52.0	+0.7	73	15	59	37	1	45	26	46	42	74	3.81	+0.1	11	5,853	sw.	52	s.	24	14	6	8	4.1	0.0	....
San Jose	141	12	110	29.96	30.12	.....	50.5	−0.1	73	15	62	25	1	40	36	....	....	....	4.88	+2.3	11	4,717	s.	46	se.	25	11	6	11	4.9	0.0	....
South. Pacific Coast Region.							**53.3**	**+0.7**											**70**	**3.60**	**+1.2**									**4.4**		
Fresno	327	89	98	29.78	30.14	+0.06	51.4	+2.2	73	7	62	29	1	41	31	45	38	64	1.07	−0.3	9	4,517	nw.	28	nw.	25	15	6	7	4.0	0.0	....
Los Angeles	338	159	191	29.76	30.13	+ .07	55.3	+1.2	82	4	64	41	18	46	33	48	41	68	4.49	+1.6	9	3,977	ne.	27	sw.	17	11	9	8	4.9	0.0	....
San Diego	87	62	70	30.04	30.14	+ .08	54.7	+0.1	75	3	62	41	7	47	25	49	45	76	1.84	−0.1	8	3,972	nw.	34	s.	17	16	7	5	3.9	0.0	....
San Luis Obispo	291	32	40	29.94	30.16	+ .05	51.9	−0.6	80	4	62	31	18	42	43	47	42	74	7.01	+3.4	12	3,387	n.	24	ne.	3	13	5	10	5.0	0.0	....
West Indies.																																	
San Juan, P. R	82	8	54	30.00	30.09	+0.04	73.2	.....	80	11	78	62	13	68	16	....	....	....	2.86	+0.4	15	9,763	ne.	40	ne.	28	11	15	2	3.7	0.0	....
Panama Canal.																																	
Balboa Heights	118	7	97	29.82	29.95	.....	78.2	.....	89	16	87	66	5	69	21	70	68	82	0.19	−0.7	2	7,230	n.	32	ne.	3	11	17	0	4.0	0.0	....
Colon	25	5	71	29.93	29.96	.....	79.2	.....	84	28	83	73	3	76	10	73	71	79	0.45	−1.2	9	11,357	nw.	39	nw.	22	12	14	2	4.2	0.0	....
Alaska.																																	
Juneau	....	....	....	....	....	.....	27.2	.....	46	14	32	−15	1	22	19	24	16	68	5.91	.....	13	3,996	ne.	28	e.	18	13	3	12	5.3	13.7	T.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during February, 1917, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	14			0.98														0.54			
Albany, N. Y	26			0.52														0.24			
Alpena, Mich	19			0.32														*			
Amarillo, Tex	14			0.22														*			
Anniston, Ala	1	D. N. a. m.	D. N. a. m.	1.01	12:44 a. m.	1:05 a. m.	0.01	0.29	0.32	0.36	0.51	0.54									
	20	12:30 a. m.	6:48 a. m.	1.80	1:40 a. m.	1:58 a. m.	0.03	0.11	0.36	0.50	0.68										
					4:37 a. m.	5:16 a. m.	0.78	0.07	0.14	0.21	0.31	0.36	0.48	0.66	0.82						
	23	12:53 p. m.	5:05 p. m.	1.19	1:05 p. m.	1:20 p. m.	0.02	0.12	0.37	0.52											
Asheville, N. C	20			0.51														0.32			
Atlanta, Ga	1	D. N. a. m.	5:10 a. m.	0.87	12:21 a. m.	2:51 a. m.	0.01	0.13	0.22	0.31	0.39	0.45	0.50								
	19	D. N. a. m.	7:20 a. m.	0.85	4:06 a. m.	4:33 a. m.	0.21	0.07	0.11	0.21	0.29	0.45	0.55								
	19	11:27 a. m.	1:20 p. m.	0.62	11:45 a. m.	12:00 noon	0.03	0.13	0.37	0.51											
Atlantic City, N. J	24			0.37														0.15			
Augusta, Ga	19			0.52														0.26			
Baker, Oreg	23–24			0.36														*			
Baltimore, Md	23			0.21														0.10			
Bentonville, Ark	14			0.85														0.03			
Binghamton, N. Y	24			0.12														0.08			
Birmingham, Ala	19	D. N. a. m.	7:10 a. m.	1.73	4:58 a. m.	5:59 a. m.	0.44	0.06	0.24	0.46	0.52	0.56	0.58	0.65	0.70	0.73	0.77	0.93	1.07		
	20	D. N. a. m.	D. N. a. m.	1.15	3:53 a. m.	4:12 a. m.	0.43	0.07	0.34	0.50	0.61										
Bismarck, N. Dak	24–25			0.23														*			
Block Island, R. I	26–27			0.30														0.15			
Boise, Idaho	22–23			0.30														*			
Boston, Mass	26			0.69														0.26			
Buffalo, N. Y	3–4			0.57														*			
Burlington, Vt	26			0.77														*			
Cairo, Ill	19			0.53														0.33			
Canton, N. Y	8–9			0.46														*			
Charles City, Iowa	19			0.80														*			
Charleston, S. C	18			1.22														0.29			
Charlotte, N. C	23			0.95														0.27			
Chattanooga, Tenn	20	12:08 a. m.	7:35 a. m.	1.22	1:50 a. m.	2:41 a. m.	0.22	0.14	0.20	0.23	0.25	0.35	0.42	0.52	0.61	0.69	0.90	0.94			
Cheyenne, Wyo	17–18			0.29														*			
Chicago, Ill	8			0.24														*			
Cincinnati, Ohio	23			0.76														0.20			
Cleveland, Ohio	4–5			0.32														*			
Columbia, Mo	19			0.22														*			
Columbia, S. C	19			1.37														0.59			
Columbus, Ohio	19			0.19														0.17			
Concord, N. H	26			0.43														*			
Concordia, Kans	8			0.07														*			
Corpus Christi, Tex	11			T.														T.			
Dallas, Tex	10			0.35														0.28			
Davenport, Iowa	4			0.10														*			
Dayton, Ohio	23			0.54														*			
Del Rio, Tex	11			0.06														0.04			
Denver, Colo	13–14			0.15														*			
Des Moines, Iowa	4			0.25														*			
Detroit, Mich	8			0.20														*			
Devils Lake, N. Dak	22			0.15														*			
Dodge City, Kans	28			0.04														0.04			
Dubuque, Iowa	19			0.08														*			
Duluth, Minn	21			0.30														*			
Eastport, Me	20			0.56														*			
Elkins, W. Va	27–28			0.76														0.28			
El Paso, Tex	7			T.														T.			
Erie, Pa	4			0.33														*			
Escanaba, Mich	21			0.29														*			
Eureka, Cal	24–25			2.00														0.29			
Evansville, Ind	23			0.30														0.12			
Flagstaff, Ariz	17–18			0.84														*			
Fort Smith, Ark	14			0.62														0.17			
Fort Wayne, Ind	23			0.32														*			
Fort Worth, Tex	10			0.50														0.49			
Fresno, Cal	17			0.23														0.12			
Galveston, Tex	6–7			1.81														0.54			
Grand Haven, Mich	3–4			0.39														*			
Grand Junction, Colo	16–17			0.08														*			
Grand Rapids, Mich	3–4			0.29														*			
Green Bay, Wis	19			0.30														*			
Hannibal, Mo	4			0.04														*			
Harrisburg, Pa	28			1.15														*			
Hartford, Conn	26			0.23														0.12			
Hatteras, N. C	20			0.44														0.38			
Havre, Mont	24–25			0.52														*			
Helena, Mont	24–25			0.82														*			
Houghton, Mich	16–17			0.52														*			
Houston, Tex	14	2:35 p. m.	3:12 p. m.	0.65	2:38 p. m.	2:51 p. m.	0.01	0.13	0.38	0.62											
Huron, S. Dak	18			0.17														*			
Independence, Cal	21–22			0.30														*			
Indianapolis, Ind	18–19			0.41														*			
Iola, Kans	8			0.05														*			
Jacksonville, Fla	20	6:32 p. m.	7:15 p. m.	0.31	6:32 p. m.	6:38 p. m.	0.00	0.28	0.30												
Kalispell, Mont	24–25			0.64														*			
Kansas City, Mo	4			0.05														*			
Keokuk, Iowa	22–23			0.08														*			
Key West, Fla	26	11:14 a. m.	11:30 a. m.	0.35	11:14 a. m.	11:24 a. m.	0.00	0.17	0.34												
Knoxville, Tenn	20			0.76														0.34			
La Crosse, Wis	19			0.54														*			
Lander, Wyo	16–17			0.48														*			
Lansing, Mich	22–23			0.16														*			
Lewiston, Idaho	24–25			0.38														*			
Lexington, Ky	23			0.41														0.27			
Lincoln, Nebr	4			0.02														*			
Little Rock, Ark	14			0.92														*			
Los Angeles, Cal	22			1.15														0.26			
Louisville, Ky	23			0.74														0.44			
Ludington, Mich	19			0.42														*			
Lynchburg, Va	1			0.44														0.19			
Macon, Ga	18			1.10														0.37			

* Self-register not in use.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during February, 1917, at all stations furnished with self-registering gages.*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Madison, Wis.	19			0.34														*			
Marquette, Mich.	19–20			0.51														*			
Memphis, Tenn.	28			0.65														0.23			
Meridian, Miss.	18–19	D. N. p. m.	D. N. a. m.	0.58	11:44 p. m.	12:07 a. m.	0.11	0.05	0.14	0.28	0.40	0.46									
Miami, Fla.	26			0.20														0.20			
Milwaukee, Wis.	19			0.25														*			
Minneapolis, Minn.	19			0.17														*			
Mobile, Ala.	17	12:02 p. m.	7:25 p. m.	2.54	4:56 p. m.	5:47 p. m.	0.06	0.29	0.68	0.94	1.19	1.28	1.44	1.86	2.15	2.24	2.29	2.33			
Modena, Utah.	18–19			0.40														*			
Montgomery, Ala.	18			1.82														0.69			
Moorhead, Minn.	18–19			0.19														*			
Mount Tamalpais, Cal.	19–20	D. N. p. m.	12:35 p. m.	1.61	12:30 a. m.	12:53 a. m.	0.71	0.05	0.11	0.30	0.45	0.49									
Nantucket, Mass.	1			0.50														0.21			
Nashville, Tenn.	23			0.43														0.43			
New Haven, Conn.	9			0.51														*			
New Orleans, La.	7–8			1.03														*			
New York, N. Y.	22			0.27														0.14			
Norfolk, Va.	24			0.41														0.22			
Northfield, Vt.	9			0.20														*			
North Head, Wash.	15			0.58														0.18			
North Platte, Nebr.	28			0.17														*			
Oklahoma, Okla.	14			0.84														*			
Omaha, Nebr.	4			0.12														*			
Oswego, N. Y.	10–11			0.46														*			
Palestine, Tex.	11			1.13														0.58			
Parkersburg, W. Va.	23			0.75														0.26			
Pensacola, Fla.	1			0.86														0.72†			
Peoria, Ill.	19			0.10														0.04			
Philadelphia, Pa.	27–28			0.86														*			
Phoenix, Ariz.	18			0.72														0.19			
Pierre, S. Dak.	18–19			0.16														*			
Pittsburgh, Pa.	23			0.50														0.20			
Pocatello, Idaho.	21–22			0.60														*			
Point Reyes Light, Cal.	23			0.65														0.16			
Port Angeles, Wash.	22			0.65														*			
Port Huron, Mich.	3–4			0.12														*			
Portland, Me.	4–5			1.44														*			
Portland, Oreg.	10			0.32														0.15			
Providence, R. I.	9			0.46														*			
Pueblo, Colo.	27–28			0.19														*			
Raleigh, N. C.	1			0.55														0.44			
Rapid City, S. Dak.	7–8			0.16														*			
Reading, Pa.	24			0.37														0.18			
Red Bluff, Cal.	24			2.12														*			
Reno, Nev.	24–25			0.86														*			
Richmond, Va.	23–24			0.75														*			
Rochester, N. Y.	19			0.30														*			
Roseburg, Oreg.	19			0.81														0.17			
Roswell, N. Mex.	14–15			0.18														*			
Sacramento, Cal.	24			1.82														0.28			
Saginaw, Mich.	19			0.11														*			
St. Joseph, Mo.	4			0.02														*			
St. Louis, Mo.	18–19			0.28														*			
St. Paul, Minn.	24–25			0.20														*			
Salt Lake City, Utah.	17–18			0.44														*			
San Antonio, Tex.	6			0.42														0.12			
San Diego, Cal.	13			0.34														0.29			
Sand Key, Fla.	9			0.34														0.26			
Sandy Hook, N. J.	28			0.84														*			
Sandusky, Ohio.	8			0.22														*			
San Francisco, Cal.	21			1.03														0.26			
San Jose, Cal.	24			2.58														0.45			
San Luis Obispo, Cal.	21			2.67														0.33			
Santa Fe, N. Mex.	13–14			0.12														*			
Sault Ste. Marie, Mich.	25–26			0.37														*			
Savannah, Ga.	28			0.72														0.54			
Scranton, Pa.	4–5			1.06														*			
Seattle, Wash.	10			0.33														0.08			
Sheridan, Wyo.	3–4			0.11														*			
Shreveport, La.	23			0.26														0.26			
Sioux City, Iowa.	19			0.40														*			
Spokane, Wash.	24–25			0.34														*			
Springfield, Ill.	19			0.31														*			
Springfield, Mo.	14			0.23														*			
Syracuse, N. Y.	5–6			0.52														*			
Tacoma, Wash.	11			0.39														0.10			
Tampa, Fla.	1	6:42 p. m.	9:00 p. m.	0.66	6:57 p. m.	7:12 p. m.	0.02	0.19	0.29	0.35											
Tatoosh Island, Wash.	2–3			2.47														0.28			
Taylor, Tex.	6–7			0.44														0.13			
Terra Haute, Ind.	23			0.40														*			
Thomasville, Ga.	1	6:53 a. m.	12:45 p. m.	1.04	7:46 a. m.	7:58 a. m.	0.08	0.21	0.57	0.62											
	15	D. N. a. m.	6:25 a. m.	0.83	4:45 a. m.	5:04 a. m.	0.05	0.38	0.54	0.61	0.69										
Toledo, Ohio.	4–5			0.23														*			
Tonopah, Nev.	16–17			0.38														*			
Topeka, Kans.	4			T.														T.			
Trenton, N. J.	27–28			0.43														*			
Valentine, Nebr.	18			0.18														*			
Vicksburg, Miss.	18–19	10:15 p. m.	D. N. a. m.	0.71	11:13 p. m.	11:46 p. m.	0.01	0.18	0.25	0.27	0.27	0.29	0.47	0.68							
	23	9:24 a. m.	12:35 p. m.	0.97	10:07 a. m.	10:48 a. m.	0.02	0.05	0.11	0.26	0.32	0.37	0.50	0.63	0.71	0.74					
Walla Walla, Wash.	24–25			0.56†														*			
Washington, D. C.	15			0.57														*			
Wausau, Wis.	19			0.42														*			
Wichita, Kans.	8			T.														T.			
Williston, N. Dak.	24–25			0.46														*			
Wilmington, N. C.	19			0.65														0.25			
Winnemucca, Nev.	16			0.07														*			
Wytheville, Va.	23			0.64														0.23			
Yankton, S. Dak.	18–19			0.19														*			
Yellowstone Park, Wyo.	24–25			0.69														*			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE III.—*Data furnished by the Canadian Meteorological Service, February, 1917.*

Stations.	Altitude above M. S. L.* Jan. 1, 1916.	Pressure.			Temperature.						Precipitation.		
		Station reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+ mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	*Inches.*	*Inches.*	*Inches.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*Inches.*	*Inches.*	*Inches.*
St. Johns, N. F.	125	29.48	29.62	−0.21	21.4	−0.6	27.4	15.5	40	− 4	8.32	+3.41	61.0
Sydney, C. B. I.	48	29.75	29.79	− .13	18.7	−0.6	29.8	7.5	48	−14	4.32	+0.23	7.0
Halifax, N. S.	88	29.71	29.82	− .13	21.6	−0.8	31.7	11.5	47	− 8	5.28	+0.12	9.6
Yarmouth, N. S.	65	29.75	29.82	− .17	23.6	−2.2	30.7	16.4	48	1	5.72	+0.98	21.5
Charlottetown, P. E. I.	38	29.73	29.77	− .18	15.3	−2.3	24.2	6.3	43	−15	2.97	−0.09	11.1
Chatham, N. B.	28	29.77	29.80	−0.16	10.3	−2.2	22.7	− 2.1	39	−23	2.53	−0.63	22.1
Father Point, Que.	20	29.77	29.80	− .18	6.4	−5.1	14.7	− 1.9	31	−18	3.00	+0.79	30.0
Quebec, Que.	296	29.51	29.85	− .14	6.2	−5.6	15.1	− 2.8	36	−22	2.43	−0.84	24.1
Montreal, Que.	187	29.67	29.90	− .12	8.8	−5.7	16.8	0.8	39	−20	2.37	−0.70	21.1
Stonecliffe, Ont.	489	29.27	29.92	− .09	3.6	−6.3	16.6	− 9.3	40	−32	1.45	−0.55	14.5
Ottawa, Ont.	236	29.64	29.98	−0.04	6.7	−5.0	18.0	− 4.5	41	−26	1.76	−0.93	17.6
Kingston, Ont.	285	29.62	29.96	− .08	12.6	−5.2	22.6	2.7	40	−19	2.95	−0.49	15.4
Toronto, Ont.	379	29.54	29.97	− .07	17.2	−4.3	25.4	9.0	45	−11	0.90	−1.71	6.0
White River, Ont.	1,244	28.50	29.91	− .11	−8.5	−8.7	7.5	−24.5	22	−50	1.34	−0.18	13.4
Port Stanley, Ont.	592	29.35	30.02	− .04	16.2	−6.6	25.1	7.4	42	−18	1.61	−1.60	11.8
Southampton, Ont.	656	29.21	.....	.....	11.7	−8.2	21.2	2.2	40	−26	3.57	+0.67	30.4
Parry Sound, Ont.	688	29.20	29.94	−0.07	6.2	−8.1	18.2	− 5.7	40	−31	2.27	−0.65	22.7
Port Arthur, Ont.	644	29.25	30.01	− .04	1.5	−4.9	12.0	− 9.0	27	−26	0.78	−0.12	7.8
Winnipeg, Man.	760	29.25	30.16	+ .06	−5.9	−4.3	2.8	−14.6	28	−34	0.88	−0.10	8.8
Minnedosa, Man.	1,690	28.19	30.14	+ .05	−6.0	−3.3	4.0	−16.0	25	−43	1.57	+0.96	15.7
Qu'Appelle, Sask.	2,115	27.73	30.14	+0.06	−4.1	−3.5	5.4	−13.5	34	−47	0.97	+0.24	7.7
Medicine Hat, Alberta.	2,144	27.76	30.18	+ .13	6.0	−5.2	15.7	− 3.7	43	−38	0.55	−0.12	4.7
Swift Current, Sask.	2,392	27.42	30.17	+ .10	−0.4	−8.4	8.7	− 9.5	39	−40	1.08	+0.34	10.8
Calgary, Alberta.	3,428	26.42	30.15	+ .16	12.0	−1.5	23.4	0.6	56	−38	0.50	−0.13	5.0
Banff, Alberta.	4,521	25.31	30.11	+ .13	12.6	−6.6	25.1	0.1	44	−44	0.34	−0.58	3.4
Edmonton, Alberta.	2,150	27.74	30.17	+0.15	4.7	−3.6	15.5	− 6.1	45	−50	1.19	+0.52	10.9
Prince Albert, Sask.	1,450	28.52	30.19	+ .10	−4.0	−1.0	6.7	−14.6	38	−45	0.10	−0.59	1.0
Battleford, Sask.	1,592	28.34	30.21	+ .12	−4.2	−4.3	7.0	−15.3	41	−44	0.20	−0.17	2.0
Kamloops, B. C.	1,262	28.88	30.24	+ .28	19.5	−8.8	26.5	12.4	40	−23	0.59	−0.20	4.0
Victoria, B. C.	230	29.82	30.08	+ .08	37.6	−1.9	41.0	34.1	47	22	2.11	−1.99	11.0
Barkerville, B. C.	4,180	25.64	30.10	+0.19	14.7	−4.2	22.6	6.8	40	−34	2.50	−0.56	25.0
Hamilton, Bermuda.	151	29.97	30.14	+ .03	60.6	−0.9	66.2	54.9	71	45	2.56	−1.88	0.0
Late report—January, 1917.													
Banff, Alberta.	4,521	25.24	30.05	+0.05	11.3	−0.8	20.0	2.7	40	−39	0.72	−0.47	7.2

* See description of Table III in this REVIEW, January, p. 40—C. A., jr.

Chart I. Hydrographs of Several Principal Rivers, February, 1917.

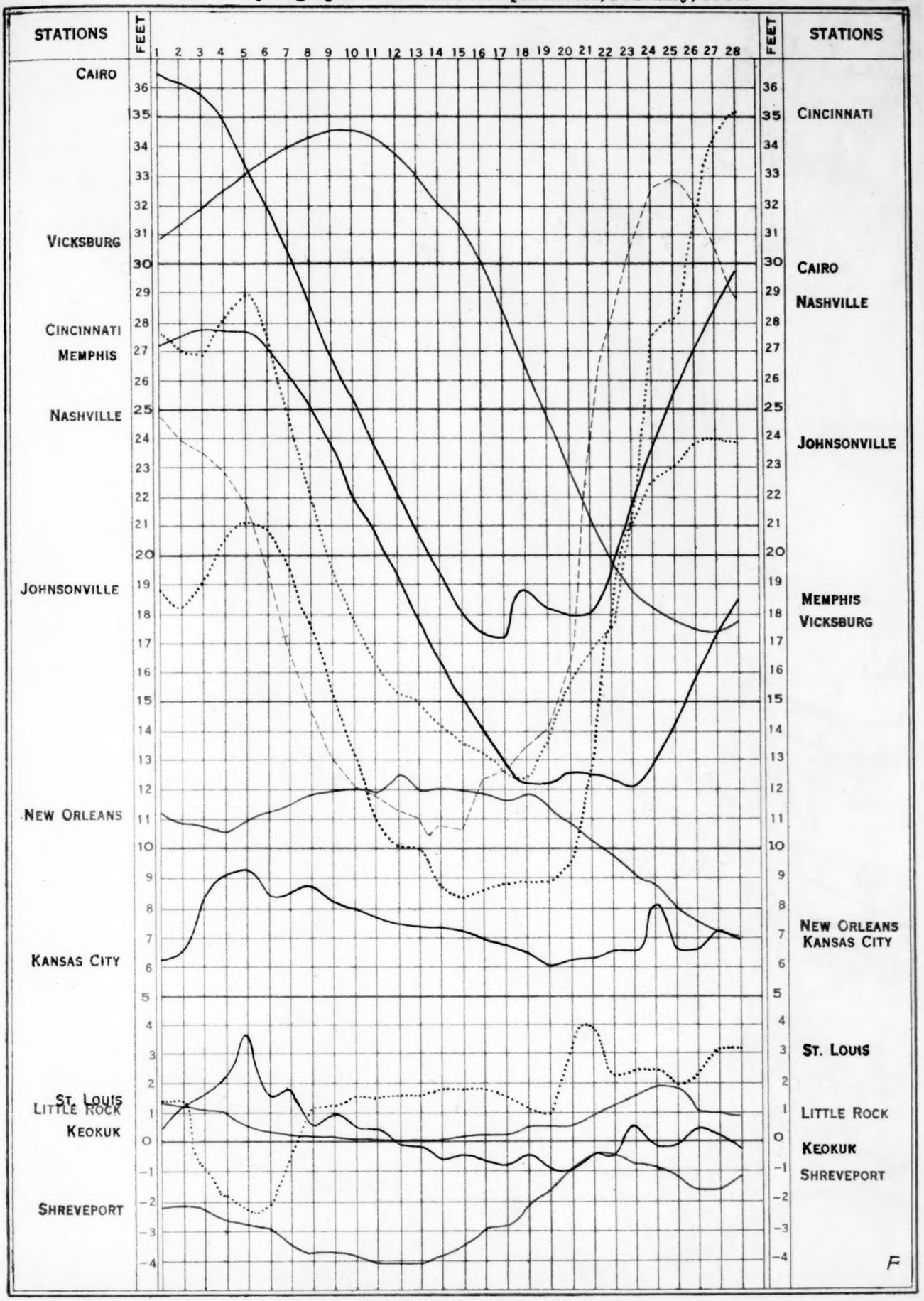


Chart II. Tracks of Centers of High Areas, February, 1917.

(Plotted by Charles A. Donnel.)

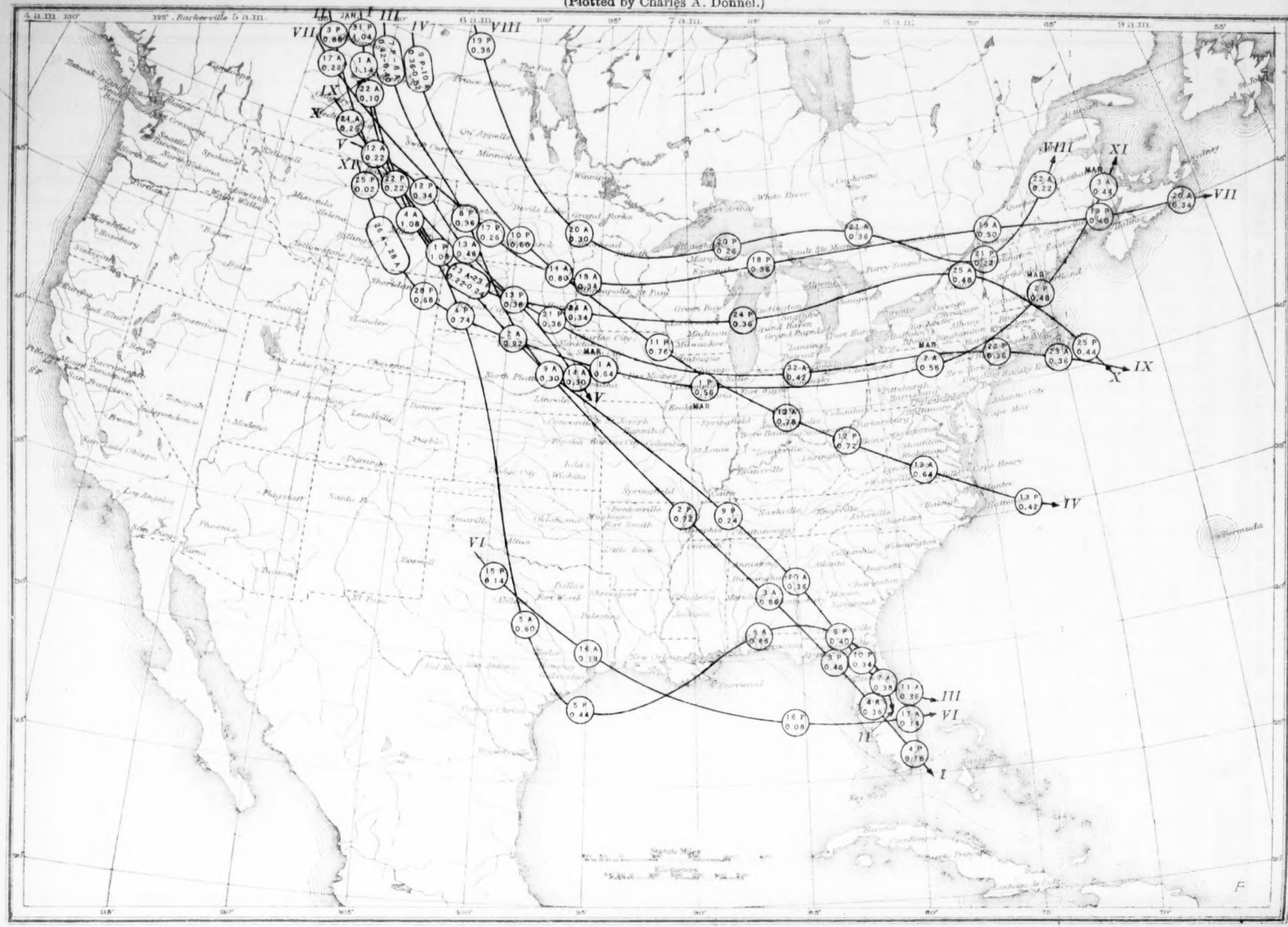


Chart III. Tracks of Centers of Low Areas, February, 1917.

Chart III. Tracks of Centers of Low Areas, February, 1917.

(Plotted by Charles A. Donnel.)

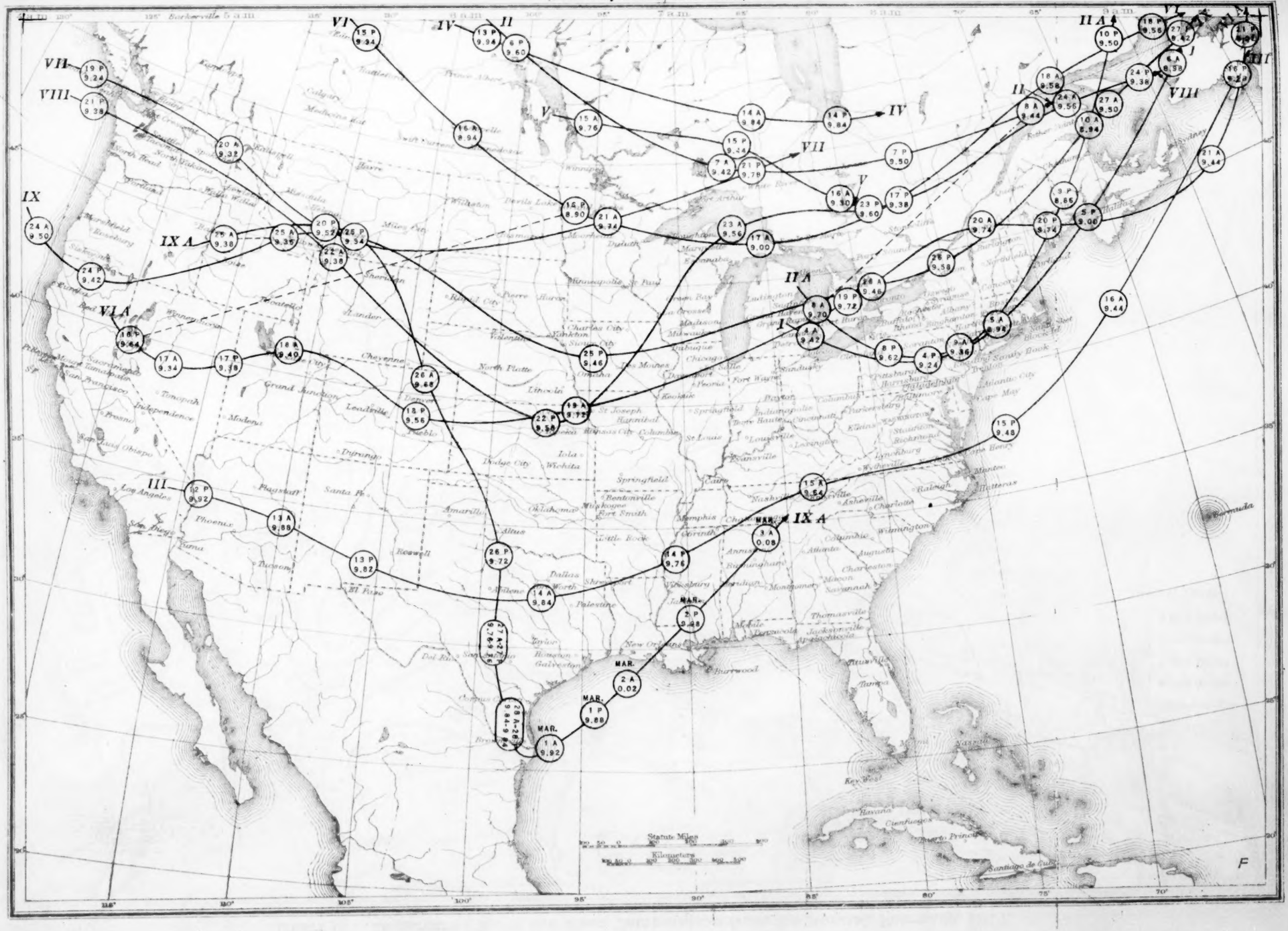


Chart IV. Departure (°F.) of the Mean Temperature from the Normal, February, 1917.

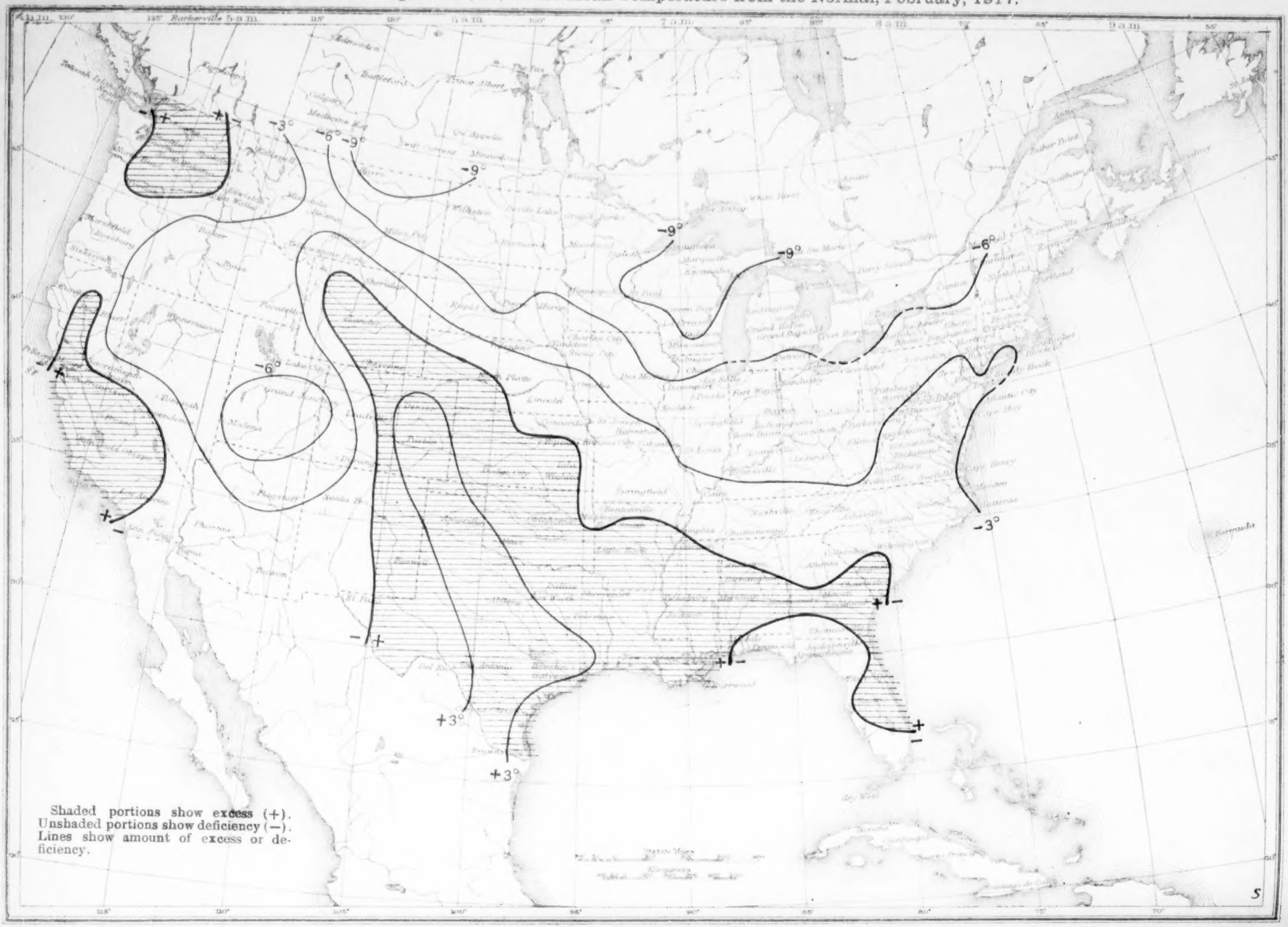


Chart V. Total Precipitation, February, 1917.

Chart V. Total Precipitation, February, 1917.

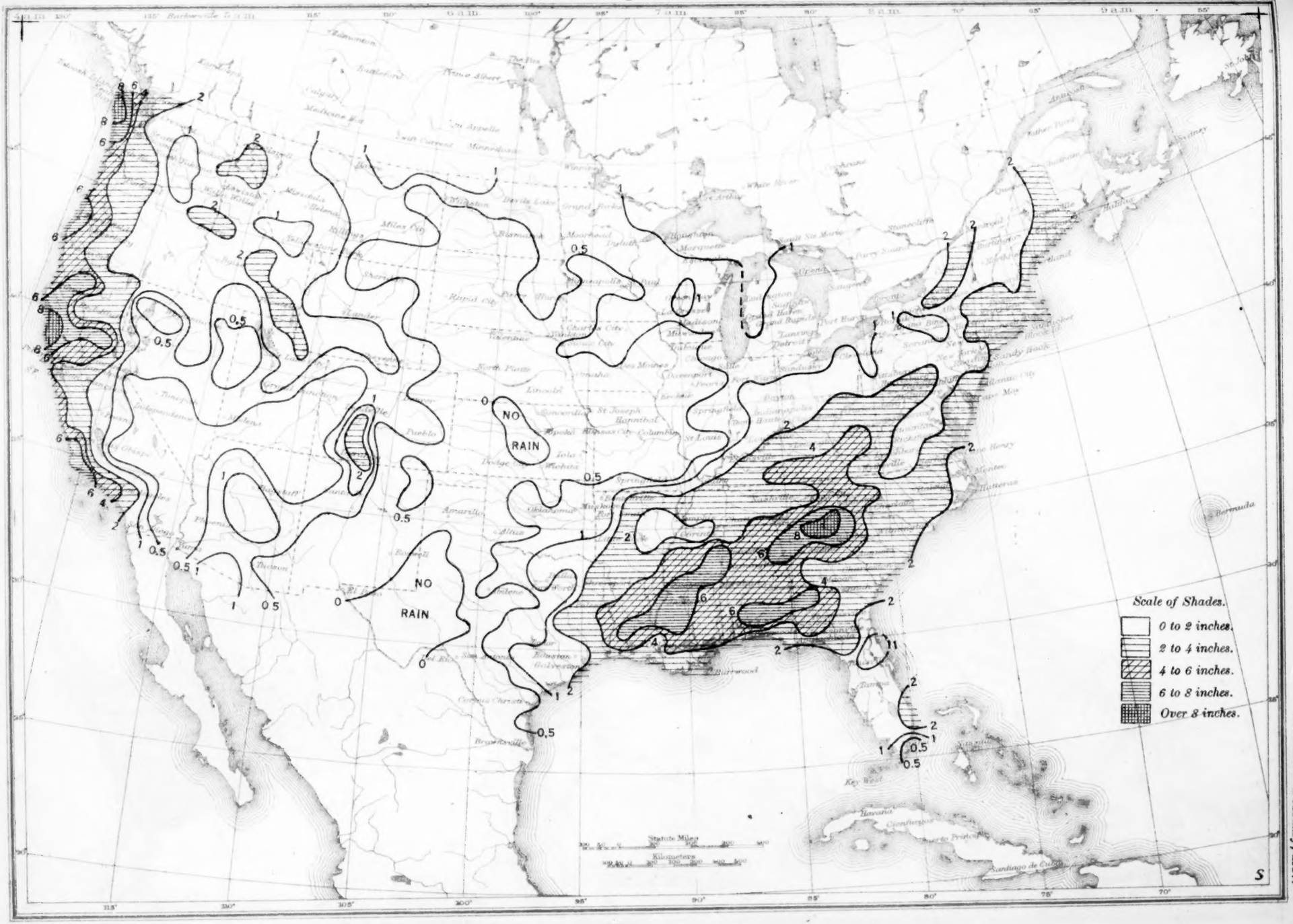


Chart VI. Percentage of Clear Sky between Sunrise and Sunset, February, 1917.

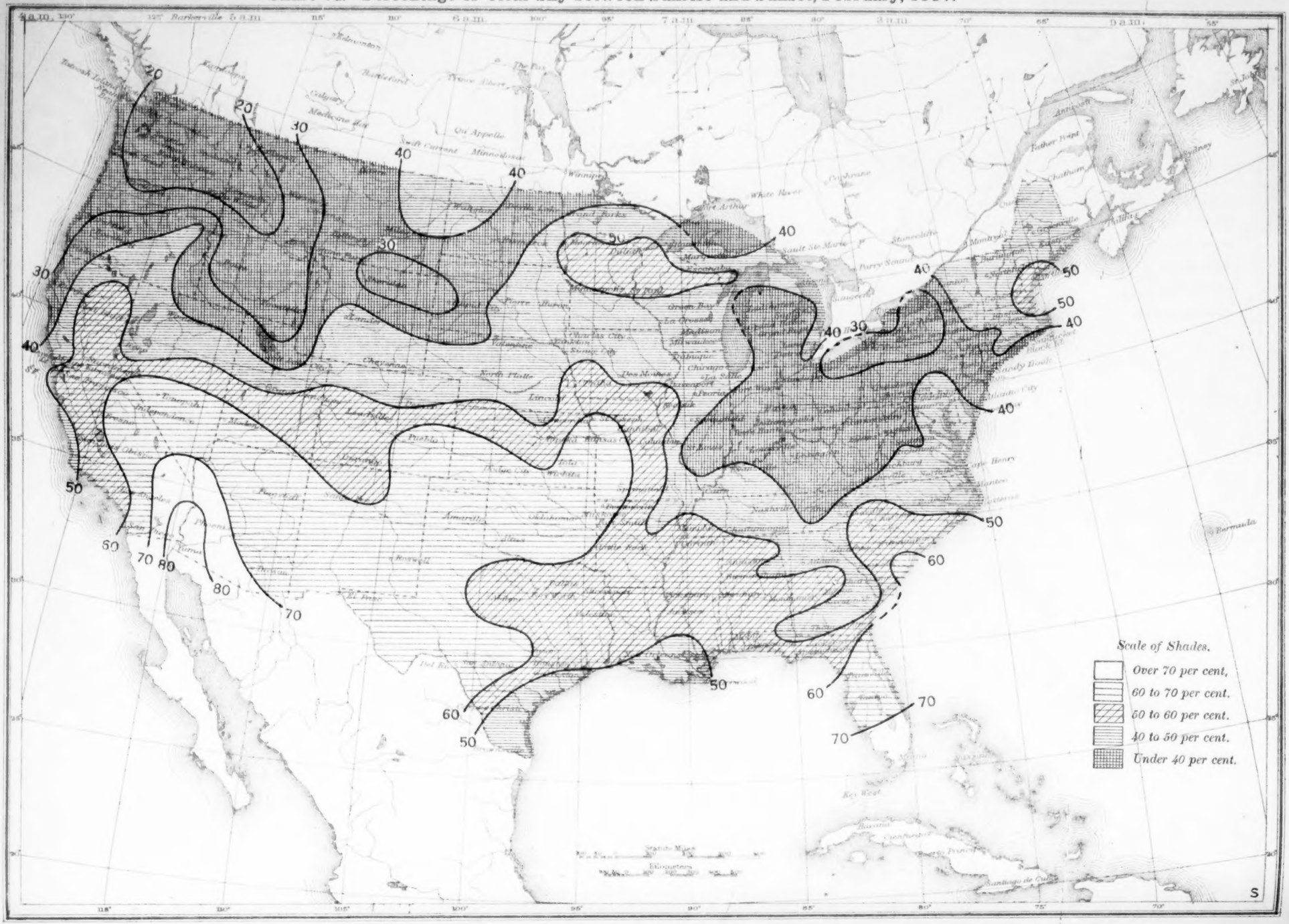


Chart VII. Isobars and Isotherms at Sea Level; Prevailing Winds, February, 1917.

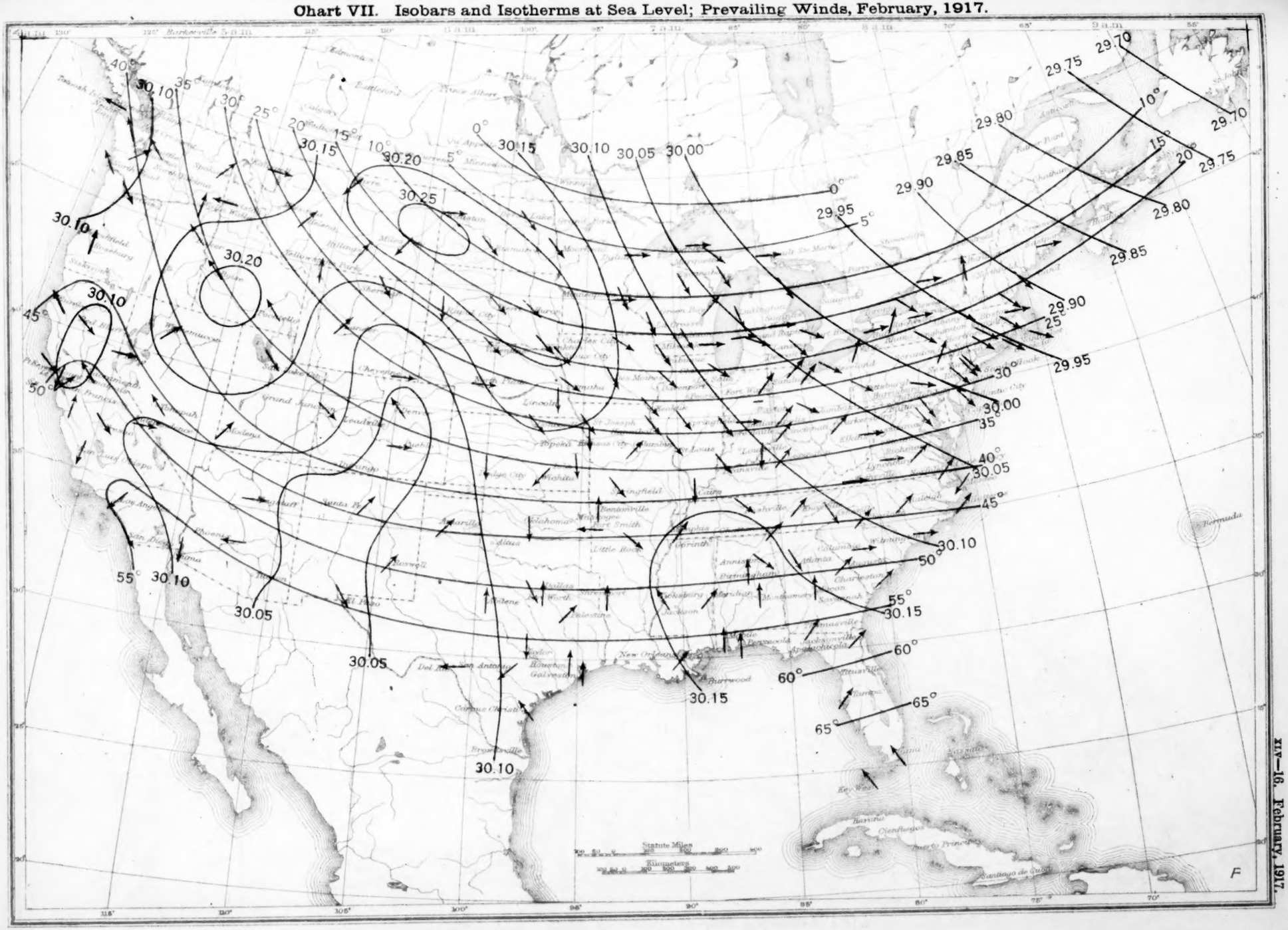
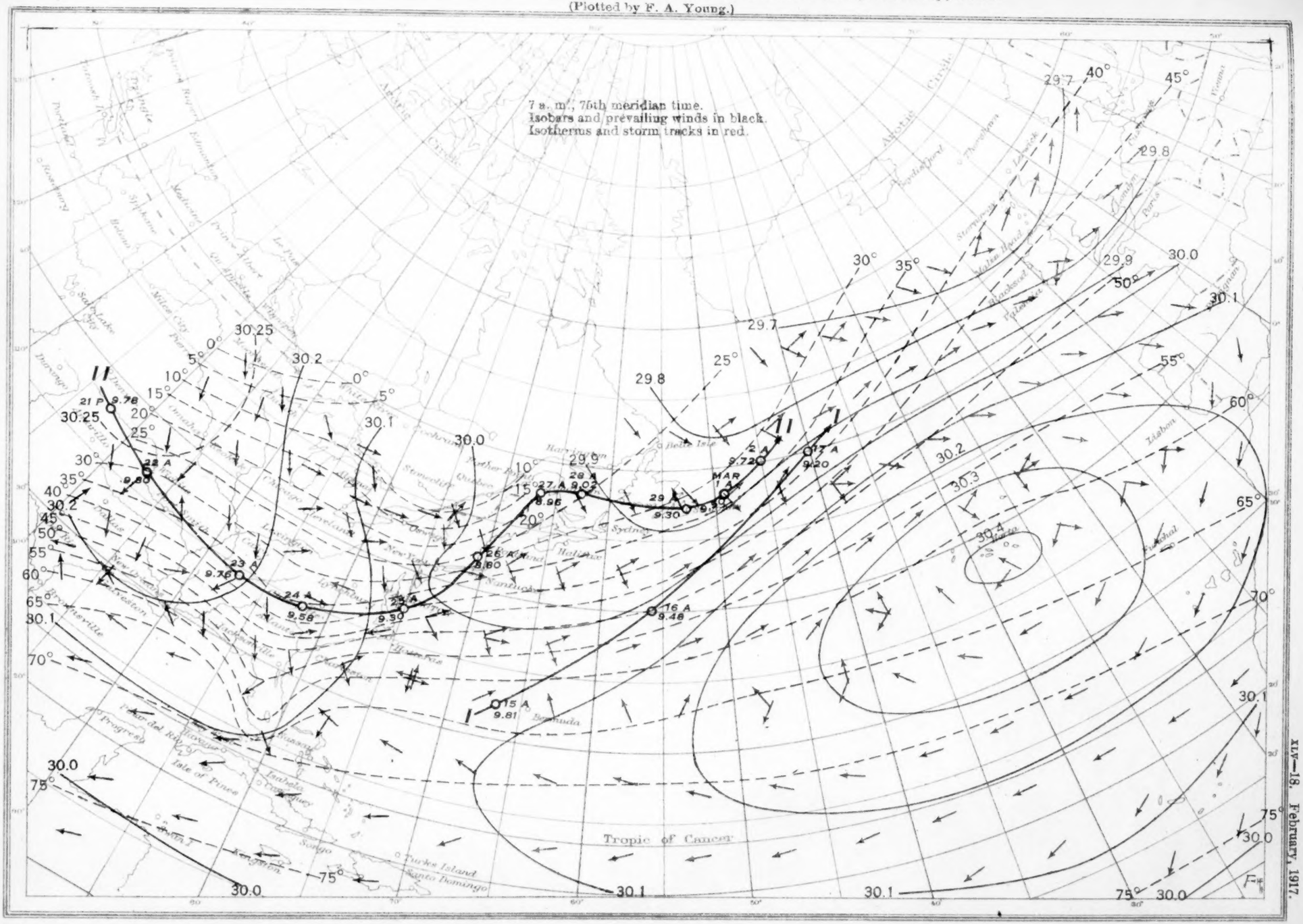


Chart VIII. Total Snowfall, Inches, February, 1917.

Chart IX. Means of Meteorological Data for North Atlantic Ocean, February, 1916.

Chart IX. Means of Meteorological Data for North Atlantic Ocean, February, 1916.

(Plotted by F. A. Young.)